PROJECT	ПРОЕКТ
SHELTER IMPLEMENTATION PLAN (SIP) NEW SAFE CONFINEMENT DESIGN, CONSTRUCTION AND COMMISSIONING CONTRACT N° SIP08-1-001	**ПЛАН ОСУЩЕСТВЛЕНИЯ МЕРОПРИЯТИЙ (ПОМ) НОВЫЙ БЕЗОПАСНЫЙ КОНФАЙНМЕНТ КОНТРАКТ НА ПРОЕКТИРОВАНИЕ, СТРОИТЕЛЬСТВО И ВВОД В ЭКСПЛУАТАЦИЮ № SIP08-1-001**
EMPLOYER	ЗАКАЗЧИК
THE STATE SPECIALIZED ENTERPRISE "CHERNOBYL NPP"	ГОСУДАРСТВЕННОЕ СПЕЦИАЛИЗИРОВАННОЕ ПРЕДПРИЯТИЕ "ЧЕРНОБЫЛЬСКАЯ АЭС"
ENGINEER	ИНЖЕНЕР
THE PROJECT MANAGEMENT UNIT (PMU)	**ГРУППА УПРАВЛЕНИЯ ПРОЕКТОМ (ГУП)**
CONTRACTOR	ПОДРЯДЧИК
NOVARKA, a Joint Venture made of : VINCI Construction Grands Projets (VCGP, leader) and Bouygues Travaux Publics (ByTP, member)	Совместное предприятие NOVARKA в составе: VINCI Construction Grands Projets (VCGP-ведущая фирма) и Bouygues Travaux Publics (ByTP - участник)

Project Name Наименование проекта			Originator Автор	Sub-division автор или подразде ление		SIP Task Задача ПОМ		Task Breakdown Code Шифр позадачной разбивки				Type of Document Тип документа			Serial Number Серийный номер документа			Revision Редакция	
S	I	P	N	L	I	2	2	A	5	0	0	_	C	D	S	0	0	1	0	1

Systems, Structures & Components Important to Safety	Systems, Structures & Components Not Important to Safety	Системы, конструкции, и компоненты, важные для безопасности	Системы, конструкции, и компоненты, не важные для безопасности

DOCUMENT TITLE	НАЗВАНИЕ ДОКУМЕНТА
NSC CS-1 CONCEPT DESIGN SAFETY DOCUMENT CHAPTER 3: INITIAL DATA FOR THE NSC CS-1 DESIGN	**ПК-1 НБК ДОКУМЕНТА ПО БЕЗОПАСНОСТИ В РАМКАХ КОНЦЕПЦИИ ПРОЕКТА ПК-1 НБК** ГЛАВА 3 – ИСХОДНЫЕ ДАННЫЕ ДЛЯ ПРОЕКТИРОВАНИЯ ПК-1 НБК

ENGLISH VERSION	~~RUSSIAN VERSION~~	АНГЛИЙСКАЯ ВЕРСИЯ	~~РУССКАЯ ВЕРСИЯ~~

Rev. Ред.	Date Дата	Prepared Подготовил	Checked Проверил	Status Статус	Reason for Revision Причины изменения	Approved Утвердил
01	2008-12-04	SPO / NSH	PMI	PRE	Overhauling following comments from SIP-PMU, KSK and RA	MHR
00	2008-07-04	GMA	PMI	PRE	First issue	MHR

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ADL	Acceptable Design Level
AFAS	Automatic Fire Alarm System
AFES	Automatic Fire Extinguishing System
AFF	Automated Fire Fighting device
AFWS&E	Automatic Fire Warning System and Evacuation
AHU	Air Handling Unit
ALARA	As Low As Reasonably Achievable
ASB	Administrative & Servicing Building
BDES	Back-up Diesel Electrical Station
BSA	Baltic Altitude Scale
CB-3	Common Building – 3
CLPS	Cooling Lake Pumping Station
CCP	Central Control Panel
CD	Conceptual Design
CDF	Closed Distribution Device
CDSD	NSC CS-1 Concept Design Safety Document
CE	Critical Event
CF	Core Fragments
CF-1430	Changing Facility 1430
CFD	Computational Fluid Dynamics
CH	Central Hall
ChNPP	Chernobyl NPP
CIE	Central Intermediary Events
CMU	Cabinet Ministers of Ukraine
COP	Construction Organisation Plan
CP	Check Point
CPT	Cone Penetration Test
CS-1	First Commissioning Stage
CS-2	Second Commissioning Stage
CS-3	Third Commissioning Stage
DBE	Design Basis Earthquake
DC	Design Criteria
DCR	Design Criteria and Requirements
DP	Design Packages
DS	Deaerator Stack
DSS	Dust Suppression System

EBP-A, B	Early Biddable Project, Packages A and B
EBRD	European Bank for Reconstruction and Development
EDR	Exposure Dose Rate
EGE	Engineering & Geological Elements
EIA	Environmental Impact Assessment
EO	Expert Organisations
EN	Explanatory Note
FAS	Fire Alarm System
FCM	Fuel Containing Material
FDS	Fire Dynamics Simulator
FS	Feasibility Study
GWL	Ground Water Level
HLW	High-Level Waste
HVAC	Heating, Ventilation and Air Conditioning
IAEA	International Atomic Energy Agency
IAG	International Advisory Group
IAMS	Integrated Automated Monitoring System
ICS	Integrated Control System
ICSRM	Industrial Complex for Slid Radwaste management
IDC	Inter-Disciplinary Check
IE	Initial Event
IFT	Invitations For Tender
IHP	Industrial Heating Plant
ILW	Intermediate-level Waste
IMS	Information Measurement System
IMSM	Integrated Management Systems Manual
IS	Ionizing Source
ISDB	Integrated Shelter Database
ISF	Interim Storage Facility
ISF-2	Interim Storage Facility - 2
ISO	International Organization for Standardization
ISP NPP	Institute for Safety Problems of NPP
IWD	Identified Working Designs
KIEP	Kiev Institute Energoproekt
LANL	Los Alamos National Laboratory
LFCM	Lava-like Fuel-containing Materials
LLW	Low-Level Waste
LP	Labour Protection

LPE	Limitation of Potential Exposure
LPP	Labour Protection Program
LRTP	Liquid Radwaste Treatment Plant
LRW	Liquid Radioactive Waste
LS	Localising Structure
LSWS	Liquid & Solid Waste Storage
LWS	Liquid Waste Storage
LZ	Local Zone
MDE	Maximum Design Earthquake
MDSS	Modernized Dust Suppression System
MHU	Ministry of Health of Ukraine
MLW/LLW – LL	Medium and Low Level Long-Lived Waste
MS	Monitoring System
NAEK	National Atomic Energy Generating Company “Energoatom” of the Ministry of Fuel and Energy of Ukraine
ND	Normative Documents
NIAS	Nuclear Island Auxiliary System
NIS	No Impact on Safety
NIISK	Research Institute of Building Structures
NLA	Normative Legislative Acts
NLD	Normative & Legal Documents
NPP	Nuclear Power Plant
NRS	Nuclear and Radiation Safety
NSC	New Safe Confinement
NVS	New Ventilation Stack
OS	Chernobyl NPP Object Shelter
OSPU	General Sanitary Rules for Radiation Safety of Ukraine
P	Probability
PER	Potential Exposure Restriction
PL	Permissible Limit
PLC	Programmable Logical Controller
PMU	Project Management Unit
PM	Process Materials
PPE	Personal Protective Equipment
PPS	Physical Protection System
PuSO	Special (Transport) Treatment Point
RA	Regulatory Authorities
RAW	Radioactive Waste
RDAS	Reactor Department Auxiliary Systems

RIPM	Respiratory Individual Protection Means
RM	Radiological Monitoring
RMS	Radiation Monitoring System
RS	Radiation Safety
SACS	State Architecture and Construction Supervisory (inspection body)
SAO	Standard Access Order (for implementation work)
SAR	Safety Analysis Report
SAS	Sanitary Accommodation Space
SCR	Sanitary Compliance Report
SFMS	Structures & Foundation Monitoring System
SIP	Shelter Implementation Plan
SLRAW	Short-Lived Radioactive Waste
SMS	Seismic Monitoring System
SNF	Spent Nuclear Fuel
SNRC	State Nuclear Regulatory Committee of Ukraine
SPS	Sewage Pumping Station
SPZ	Sanitary Protected Zone
SRAW	Solid Radioactive Waste
SRS	Safety Related System
SRAWS	Solid Radioactive Waste Storage
SSC	Systems, Structures & Components
SSC IS	Systems, Structures & Components Important to Safety
SSCR	Self-sustained Chain Reaction
SSE ChNPP	State Specialized Enterprise ChNPP
SSTC NRS	State Scientific and Technical Centre for Nuclear and Radiation Safety
TD	Technical Decision
TR	Technical Requirement
TUE	Transuranium Elements
TV	Television
UAB	Unified Administrative Building
UCP	Unit Control Panel
UDO	Ukrainian Design Authority
UPS	Uninterruptible Power Supply
VS	Ventilation Stack
VS-2	Ventilation Stack 2
WD	Working Design
WEP	Work Execution Plan
WP	Work Place

FOREWORD

This section is based on the information and data available in 2007 and does not include the latest information compiled in the Shelter Status Report of 2008. NOVARKA will use updated initial data from OS-SSR 2008 during the Design".

3.1 INITIAL DATA ON NSC DESIGN

This section provides a detailed list of initial data derived from the available literature. These data are important for development of the Design of NSC. The assumptions made to supersede the missing information and the procedure to acquire them are provided in Section 3.9.

3.1.1 DESCRIPTION OF SITE ARRANGEMENT

This section provides data concerning the Chernobyl NPP site properties. In more detail, the data is provided in [4.5.37].

3.1.1.1 Geographic characteristics

The ChNPP site is restricted by river Pripyat, which is the Dnieper inflow in the north and east; tracts of land and forest are adjacent to the site from the south and west. The distance between the major Pripyat river-bed and bay to the OS site is nearly 3.6 km.

According to geo-botanical zoning, the ChNPP site is located in European deciduous forest region, which is Polessiye sub-province, Kiev-Polessiye district, East European province [5.1.5]. Forestlands occupy 70 % of the Exclusion Zone. The main part of forestland consists of pine-trees, oak, birch, asp and alder-tree.

There are no state reserves and preserved forest farming in immediate vicinity of the ChNPP site. There are no settlements for rare and endangered animal species [5.1.5].

The ChNPP site is located in the Exclusion Zone, which is about 2,8 thousand km^2. The distance from the OS site to the state boundary of Belarus is about 10 km.

After the ChNPP accident, the public of the settlements within the Exclusion Zone was either evacuated or re-settled. However, certain percentage of the public moved back (so-called self-settlers) in the Exclusion Zone. As of January 2006 200 people lived in 11 villages and 147 people lived in the town of Chernobyl [5.3.42].

In total 13 000 people work in the Exclusion Zone. Only workers who work at facilities located in the Exclusion Zone have permanent access. All the attendant personnel of NSC shall be related to Category A [2.1].

Towns with populations of more than 20000 citizens, such as Ivankov and Slavutich are situated outside the Exclusion Zone boundaries, at a distance of 50 km in radius. Chernigov, with population of about 310 000 citizens (90 km away) and Kiev (150 km away) with about 3 million citizens are the nearest large cities to ChNPP site. Figure 3.1-1 shows an administration map of the Exclusion Zone.

ChNPP site is located in the second climatic region (sub-region II-B). Climate of the region is defined as temperate continental one.

3.1.1.2 Climatic characteristics

The climatic characteristics of the ChNPP site are as follows [4.3.4, 5.1.1, 5.1.5]:

Air temperature, °C:

Average annual	7.2
Absolute maximum	39
Absolute minimum	- 35
Average monthly of the coldest month (January)	- 6.1
Average monthly of the warmest month (July)	18.9

Depth of soil frost penetration, cm:	
Average	70
Maximum	128
Air humidity, %:	
Average annual relative humidity	77
Maximum humidity	90
Minimum humidity	30
Precipitation, mm:	
Average multi-annual amount of precipitation	600
Maximum annual amount of precipitation	829
Maximum monthly amount of precipitation	N/D
Maximum daily amount of precipitation (1 % probability)	190
Maximum amount of precipitation per rain	N/D
Total evaporation, mm:	
Maximum monthly amount (July)	98
Minimum monthly amount (December)	1
Total annual evaporation (from ground surface)	524
Wind speed, m/sec:	
Average annual	4.2
Maximum monthly	5.1
Minimum monthly	3.4-3.7
Average annual wind rose, %:	
North	12
Northeast	10
East	11
Southeast	14
South	9
Southwest	14
West	6
Northwest	17
Calm	7
Thunderstorm:	
Number of thunderstorm days, days:	
Average annual	30
Highest annual	45
Hail:	
Number of hail days, days:	
Average annual	2
Highest annual number	9
Ice-covered ground:	
Number of ice-covered ground days, days	
Average annual	9
Highest annual number	32
Snow cover:	
Height of snow cover, cm:	
Average	17
Maximum	41
Maximum (1 % probability)	75
Time frame of falling stable blanket of snow:	
Average	Third decade of December
Earliest	First decade of November
Time frame of snow cover stable melting:	

Average	Middle of March
Latest	Middle of April
<u>Fog:</u>	
Annual number of foggy days, days:	
Average annual	46
Maximum annual	79
Average annual fog duration, hours	291
Longest continuous duration of fog, hours	69
<u>Snowstorm</u>	
Number of snowstorm days, days:	
Average annual	10
Maximum annual	32
Average annual snowstorm duration, hours	64
Average daily snowstorm duration, hours	5,8
<u>Chernobyl waterway level (by Baltic system)</u>	
<u>High water period:</u>	
Maximum registered one, m	106,54
Maximum predicted one (1 % probability), m	110,0
Freshet period:	
Maximum predicted one (1 % probability), m	107,3
<u>Maximum Chernobyl water flow rate, m^3/sec:</u>	
High water period (1% probability)	6000
Freshet period (1% probability)	1500

The data on precipitation with recurrence period once in 100 years and once in 10000 years are presented in Section 2.3.1.9 of CDSD.

The data on wind characteristics of ChNPP site with recurrence periods once in 50, 100 and 10000 years are presented in Section 2.3.1.2 of CDSD.

The maximum wind speed is 47.3 m/sec with a 10^{-4} per year probability [4.3.4].

Storm events are observed during the period from April to September, but they are seldom during the period from October to March (1-2 times during 10 years). The largest number of thunderstorms (6-8 days during a month) has been registered from June to August. In September storm activity is gradually reducing and thunderstorms are occurring only two days a month [4.5.37].

During winter, the fog duration is from 30 to 69 hours and in summer from 2 to 5 hours. The average fog duration per day constitutes 6 hours. The annual fog duration (hours) per months of a year is provided in [4.5.37].

The data on the ground inversion characteristics are given in [4.5.37].

The average number of strong-wind days during a year is 13 (the strong wind means wind with velocity of 15 m/sec and more); the maximum number of windy days is 38. Wind velocity of 18 m/sec occurs once a year, with 21 m/sec – once 5 years, 22 m/sec – once 10 years, 24 m/sec– once 20 years [4.5.37].

The probability of maximum velocity winds of 25 m/sec and higher is 2 % (i.e., at least once during 50 years). Probability of maximum velocity winds of 32 m/sec is 1 % [5.1.5].

Squalls happen mainly during warm periods on strong convections and temperature contrasts [4.5.37]. Duration of the squall winds is insignificant. Most often (in 69 % of occasions) they last for not more than half an hour (0.6 hour to 1 hour). Under squalls, the wind speed mostly is within the limits of 21 – 35 m/s. Usually, squall winds are accompanied by heavy rains and thunderstorms, hail fall is rarely seen.

Tornado characteristics in ChNPP site are presented in Section 2.3 of CDSD.

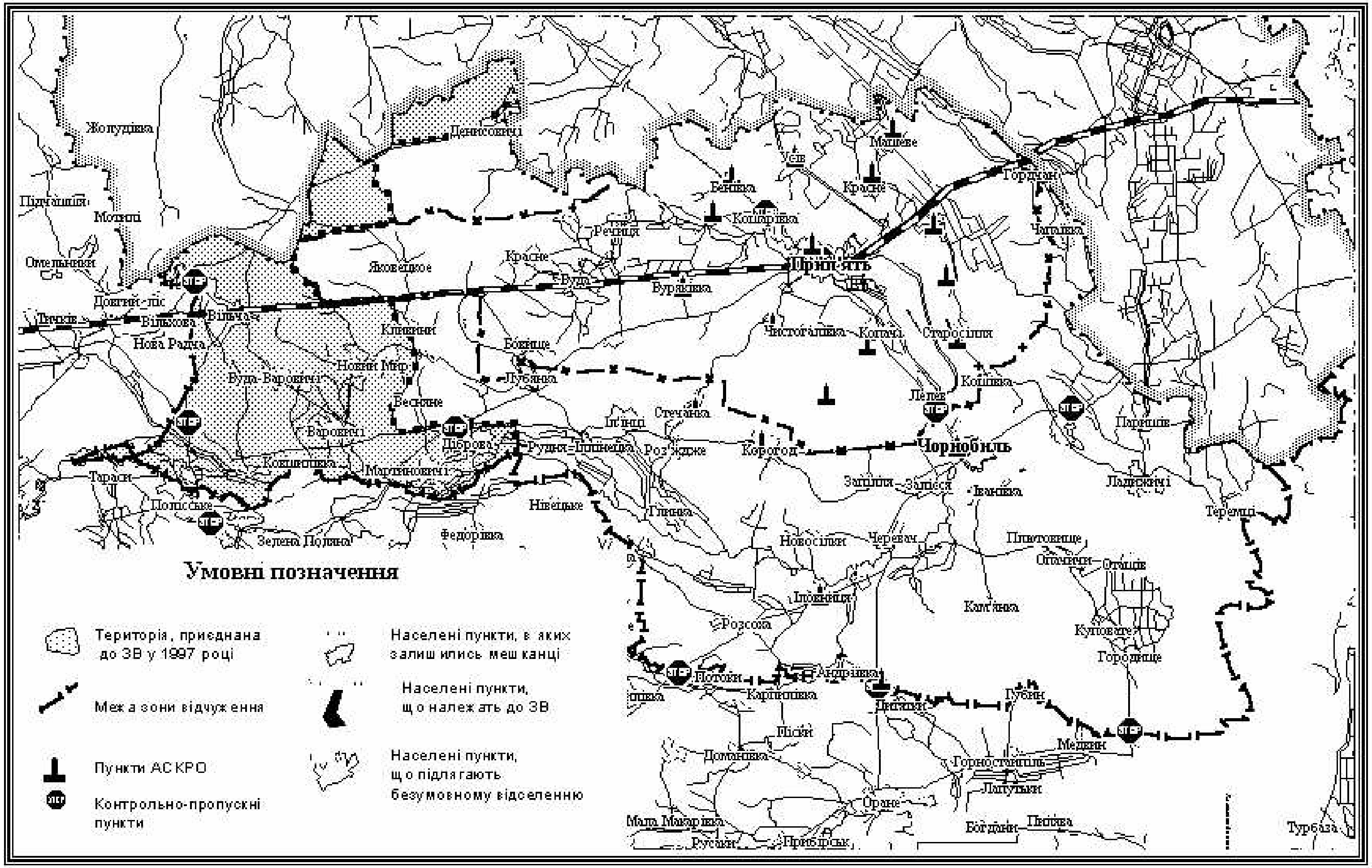


Figure 3.1-1. Administration map of the Exclusion Zone and Absolute Resettlement

3.1.2 GEOLOGICAL AND SEISMIC CONDITIONS

From a geomorphological standpoint, the ChNPP site is allocated at the East European polygenic plain. From geomorphologic standpoint, the OS site is a part of central and by-water flooded terrace of the right bank of the Pripyat River. The upper floodplain is of minor inclination towards the river Pripyat, where absolute surface elevations vary from 112-115 m above the sea level by the Baltic Altitude System (BAS). The lower central part of the region and slightly high floodplain terrace are typical of this area [5.1.16].

The ChNPP site is situated within the Ukrainian crystalline shield in the basin of the Pripyat river. Crystalline platform (pre-Cambrian rocks) lies at the depth of 400-450 m. The basin is formed by Mesozoic and Cainozoic strata. Minor and medium strata of Jurassic formation (J3) consist of sand, clay, marl, siltstone and limestone. Cretaceous deposit lies on Jurassic formation surface. Cenomanian suite formations (K2cm) consist of water-saturated fine sandstone and sand covered with fine marl and cretaceous formations of turonian, Coniacain and santonian suites (K2t-cn-st). Total thickness of cretaceous strata is estimated at 100 m. Cretaceous strata are covered with saturated glauconitic and quartz sand of Kaniv and Buchak Eocene sediments (P2kn) and P2bc); fine penetration carbonaceous clay and sand and sand and clay strata of Kyiv Eocene suite (P2kv) lie above them. Sand Neogenesis alluvial strata (N2) and Sand Quaternary strata of pleistocene and holocoen (Q1-4) cover the Kiev suite sediments from the top. The thickness of the Quaternary alluvial strata is between 25-30 m [5.1.1].

Quaternary alluvial strata are divided into medium Quaternary (a2) and upper Quaternary (a32). Upper Quaternary alluvial strata are subdivided into the following phases: flood-plain, gully and beach.

By grading, sand of minor and medium size mainly dominates in the alluvial stratum section; sand is characterised by medium- and high-compact constitution. Loose sand is detected as lens and interbed of minor thickness.

Clay soil is not so common as sand in geological section of alluvial strata. That is flood-plain sandy loam of solid and plastic consistency and plastic and liquid consistency; gully phase: minor- and medium- sandy loam peat layer, loamy sand of organic admixture of liquid consistence, lightly peat loamy soil [5.3.14]. More detailed data on OS geomorphologic and geologic conditions are presented in [5.1.4, 5.3.14].

ChNPP site is located on Eastern-European platform belonging to the mild seismic area.

The area of ChNPP is at the Eastern edge of Korosten paleosvod beyond the areas of newest explosive breaks. The earth's crust is comparatively monotonous all around the Exclusion Zone; its capacity is less than 40 km. Basalt layer is of more than 25 km thickness, granite one is from 15 to 17 km. No significant imperfections (sections and areas of the anomalous compactness) have been found [5.3.7].

The corresponding seismic characteristics of ChNPP site are presented in section 2.3. They will be used to design the seismic resistant SSC. These initial data, together with the safety classification and the associated criteria, are sufficient for the Design.

3.1.3 HYDROGEOLOGICAL AND GEOTECHNICAL DATA

The Pripyat River is the major water-way, which is the right tributary of Dnieper River; it flows into Kiev reservoir. The total length of the Pripyat River is 780 km, its width varies from 100 to 160 m, its depth falls in the range of 3-4 m, its water flow rate is 0.1 m/sec, the absolute water level in the river is 103 – 106 m and its collecting area covers 116000 km^2. The major type of

the river bed evolution is the restricted meandering. The existence of high-water and water barrier dams in ChNPP site stabilizes the river bed evolution.

The Exclusion Zone hydrographical network is well-developed.

The Pripyat River basin has lots of waterways coming from the Exclusion Zone. With the exception of the Braginka River, this flows into Dnieper-Pripyat between two rivers and falls into the Kiev reservoir.

Uzh River is the major tributary of Pripyat river within the Exclusion Zone. Grezlia and Illia rivers are the biggest left-bank tributaries of Uzh River while the right-bank tributaries are Bober and Veresnya rivers. Sakhana river collecting area is on the right bank of Pripyat river.

Pogonyansky channel flows in the Pripyat River in the northern part of the Exclusion Zone from the left bank (now the channel is tightly plugged); its collecting area is located in Belarus territory.

The hydrologic characteristics of water bodies located in the vicinity of OS site are presented in Table 3.1-1 [5.1.5].

Table 3.1-1. Hydrological characteristics of water bodies (lakes & ponds)

WATER BODY	MAXIMUM DEPTH, m	AVERAGE DEPTH, m	SQUARE OF WATER SURFACE, km^2	VOLUME (10^6 m^3)
Yanov (Prypyatsky) backwater	13.4	8.1	0.84	6.8
Semikhody backwater	5	2.1	0.41	0.86
Azbuchin Lake	5.6	2.9	0.27	0.78
ChNPP Cooling Pond	18	6.6	22.9	151

From the hydrogeologic zoning, the ChNPP site belongs to Dniper-Donetsk artesian basin. Detailed geotechnical and hydrogeologic information is presented in the geotechnical study reports [5.3.14, 5.3.15, 5.1.4].

The following water-bearing strata and complexes, which are the part of active water meter and dividing layers located in ChNPP industrial zone:

- Water-bearing complex in quaternary alluvial sediment of Pripyat valley;
- Regional aquifuge – loamy soil and loamy clay of Eocene Kiev area;
- Water-bearing strata in Eocene sediment (Bucha-Kaniv);
- Confining loamy and Cretaceous bed of upper Cretaceous (turonian and cenoman layer);
- Water-bearing complex in cenoman and Callovian sediment.

Water-bearing rocks on this territory are lithologically and spatially divided by permeable rocks, which create relatively intensive water rotation throughout the territory including the area of crystalline strata break.

Underground water of the upper water-bearing layer is limited with the Quaternary sediment stratum. The depth of the Quaternary stratum varies from 1.0 to 3.0 m which is 30 % of the ChNPP site; the depth of the underground water layer varies from 3.0 to 5.0 m and that is 50%

of its territory, 10% more of the site underground water layer is from 5 to 10 m, and at rest, 10% of the water layer is below 10m. Water-bearing rock varies from 15-30 m and water flow rate is 100-400 m^3/day at river terraces and 40-100 m^3/day at watershed areas (at watershed areas water should mix with deeper channels down to 90 m). Annual underground water level fluctuation varies from 0.5-1.0 m at watershed areas and from 1.0 to 2.0 m and deeper at water collecting valleys and river flood-lands. The average underground water flow rate varies from 80 to 200 mm/year under average precipitation rate of 600 mm/year. Carbonate, calcium and magnesium ions are the major ones in water content. The concentration of mineral salts in underground water varies from 0.1 to 0.5 mg/l [5.1.1].

The major area of unloading of artesian aquifer is located in the Pripyat River valley. The inclination of ground water surface is about 0,001. Main ground water stream flows in the direction of south-north.

In February 2002 the average point of free aquifer surface in the local zone and western part of OS was 110.06 m and 110.64 m correspondingly [5.1.16]

Documents [5.1.16, 5.3.14] present results of studies for chemical composition of ground water.

The assessment of ground water aggression is conducted for the upper water-bearing stratum of alluvial quaternary Pliocene sediments. Ground water aggression was assessed by its aggressive impact on reinforced structures and concrete. Such assessment was made for concrete of normal water penetration, which is W4 grade [2.15].

By the aggression impact rate on reinforced structures, based on hydrochemical analysis for ground water and under conditions of their permanent submergence below the ground water level, they are not aggressive and in case of periodic moistening they are mild aggressive.

The prevalent type of water aggression is with carbon dioxide (51-56%), hydrogen parameter (21-26%), bicarbonate alkalinity (17-23%), sulphate aggression (2%) [5.3.14].

According to the data available, the hydrogeological conditions of ChNPP site could be presented by two-layer diagram consisting of two water-bearing strata and one split layer. The first layer is located in alluvial Neogene Quaternary sediments and the second one is at Bucha sand, accordingly, below and higher than five metre retainer Kiev suite if middle Palaeogene.

The tendency of the ground water level is to increase, since the ceasing of operations of construction drainage and disconnection of vertical drainage boreholes in 1994. Per curvilinear regression, received as a result of reference boreholes monitoring over the period from February 1996 to February 2002, the increase of ground water level is estimated at 0,08m/year [5.1.16].

Total assessment of the OS soils was performed by the method of engineering-geological analogies. Man-made embankment and soils of OS base are divided into engineering-geological elements (EGE). The lithologic structure of the OS site grounds column is shown in Table 3.1-2 [5.1.4].

Table 3.1-2. Lithologic structure of the OS site grounds column

EGE	DESCRIPTION
1	man-made embankment
1a	backfill
2-3-4-5	flood-plain phase (a_3^2 pr)
7-9-10-12	gully phase (a_3^2 st)
14-15	beach phase (a_3^2 pl)
18-19	river-bed phase (a_3^2 pt)
20	wash-out phase (a_3^2 rf)
22-23	alluvial sediments (a_2)
24	grounds of Kiev suite ($a_2$kv)

Before ChNPP construction, the absolute surface marks were located at +114.00 - +116.00 m (per BAS).

During the liquidation of the consequences of the 1986 accident, the natural surface of the grounds on the ChNPP Site was covered with sand, gravel, crushed rock and other materials of total thickness 3 m. There is up to 10 m-thick post-accident layer in the Local zone around OS [5.1.1].

The thickness of the man-made layer, assessed from the ground surface before the accident to the existing surface, varies widely:

- 8.0 – 10.0 m nearby the Southern wall of Turbine hall along Axes 35-60 and the Northern section of the Cascade wall;
- 3.0 – 8.0 m nearby the Southern wall of Turbine hall along Axes 60-68, along the Western wall on Axis 68 and from the western section near Buttress wall;
- 0.5 – 3.0 m in the Local zone and on the OS Industrial site.

Back-filling of the foundation pit with 4.8-5.8 m of material, carried out after the creation of the foundations for Unit 4, precedes the man-caused layer. There are quaternary alluvial sandy argillaceous deposits above the clay and sand of the Palaeogene centre with capacity of 25.0-26.0 m, accompanied by sediments of argillaceous marl of Cretaceous with thickness of ~ 20.0 m [5.1.16] situated under the man-made embankment.

Table 3.1-3 [5.1.4] provides geotechnical parameters of soils summarising the available information on geotechnical researches.

According to [5.1.4] during NSC Design, the following additional information shall be taken into account:

- Shearing resistance of Kiev marl: C_{uu} = 100 kPa, φ_{uu} = 0;
- Parameters of durability of Kiev marl: C = 15 kPa, φ = 21°;
- Consolidation parameters:
  - Clay sand: $C_v = 8 \cdot 10^{-4}$ cm²/s and C_α = 0.0007;
  - Marl clay: $C_v = 1 \cdot 10^{-2}$ cm²/s and C_α = 0.0015 if P = 0.4 MPa and $C_v = 2.1 \cdot 10^{-3}$ cm²/s and C_α = 0.0025 if P = 0.8 MPa,

Where,

φ – angle of internal friction;

C_v – factor of filtration consolidation;

C_α – factor of secondary consolidation.

Table 3.1-3. Geotechnical parameters of grounds

Layer	Density ρ (t/m³)	Strength parameters s(kPa)/ φ(°)					Deformation modules E (MPa)				
		Section testing	Triaxial compression tests	Dynamic probing	Static probing	Suggested value	Section testing	Triaxial compression tests	Dynamic probing	Static probing	Sugges-ted value
Backfill of EGE 1a	2.00	0/29	5/36	-	0/39	5/32	10	30	-	39/21	25
Floodplain phase (a_3^2 pr) EGE 2 to 5	2.05	5/33	-	-	0/40	5/32	22	-	-	34/23	25
Loamy sand (a_3^2 st) EGE 9	2.00	15/20	-	0/33	0/37	10/20	5	-	5/6.5	32/19	6.5
Powder type sand (a_3^2 st) EGE 10	1.95	15/24	-	-	0/39	5/25	13	-	-	38/23	20
Powder type sand and sand (a_3^2 pl) EGE 14	2.05	0/34	0/34	0/38	0/40	0/36	21	25	20/25	47/29	25
Fine sand (a_3^2 pl) EGE 15	2.05	0/36	0/36	0/39	0/39	0/37	27	35	22/26	45/28	35
Fine sand (a_3^2 pt) EGE 18	2.05	0/34	0/36	0/40	0/39	0/37	43.5	35	26/30	49/30	40
Sand of average fineness (a_3^2 pt) EGE 19	2.05	0/34	0/40	0/40	0/39	0/38	39.5	30	26/30	52/30	40
Sand of average fineness (a_3^2 rf) EGE 20	2.05	0/34	0/39	0/38	0/39	0/38	48	30	23/27	51/30	40
Sand of average fineness (a_2) EGE 23	2.05	0/34	0/40	0/36	0/38	0/37	54	30	16/22	51/30	40
Marl clay ($a_2$kv) EGE 24	2.05	30/24	35/24	-	-	25/24	12.5	10	20/26	-	12

Section 3.9 presents data to be received in the result of the additional survey.

3.1.4 GENERAL DESCRIPTION OF THE CHNPP AND OS SITES

The main facilities located on the ChNPP industrial site (see Figure A3.1-1) are the following:

- Power units # 1, 2, 3 at the decommissioning stage. Units 1, 2 and 3 have a collective Turbine Hall. From the structural standpoint, power units 1 and 2 are separate buildings, but they have a common special body. Before the accident, power units 3 and 4 had a common

structural facility; after the accident, power unit 3 was separated from the damaged power unit 4 by a new Separating Wall, which goes through Block B and Turbine Hall.

- Fresh fuel storage facility (building No 12), adapted for temporary storage of OS HLW (room 12/2).
- Spent nuclear fuel storage facility for spent nuclear fuel (building No 48), meant for wet storage of spent nuclear fuel from power Units 1, 2 and 3;
- Storage facility of liquid and solid waste (building No 84) is situated along the Northern perimeter of the OS Local zone. System of LRAW storage includes 12 tanks of 1000 m^3 capacity each The compartments for SRAW storage are not operated. Within the frame of ICSRM, the reconstruction of compartments for temporary storage of LIL-LLW and HLW has been performed;
- SRAW storage facility (building No 85) is included in the ICSRM design, in composition of plant for SRAW removal under construction;
- LRAW storage facility (building No 80) is situated nearby the processing plant for drain, washing and regenerative waters (building No 83);
- LRAW treatment plant (LRTP) is situated near the Northern fencing of the industrial site and is intended to process LRAW, which at present are located in LSWF and LSWSF, as well as waste that will be generated during decommissioning of the ChNPP Units and OS operation.
- Solid waste processing facility (SWPF) is under construction. SWPF is intended to process SRAW of all groups, generated during retrieval of RAW from the Storage Facility as well as SRAW, generated during the ChNPP Units decommissioning and SIP projects realization at OS.
- The heating plant is a source of chemical releases. The heating plant affects the NSC CS-1 addressing summation of the chemical releases [4.3.4]. Except for IHP at the ChNPP site, two back-up diesel electrical stations (BDES-1 and BDES-2) are sources of release of harmful chemical substances to the atmosphere.
- Industrial facilities of the ChNPP Units 1, 2, 3 will not be considered as the likely source of the explosion danger for CS-1 because:
  - There are no sources of explosive danger in the main body of the power units, capable of making impact to the external facilities;
  - The documents, justifying the safety under emergencies, do not list any explosive impacts capable of influencing the OS.

The potential sources of the explosion and fire danger, which will be considered during NSC Design, are given in Table 3.1-4 [4.3.4].

Table 3.1-4. Potential sources of explosion and fire danger

SOURCE, NAME	TYPE OF SOURCE AND NEAREST DISTANCE FROM THE SOURCE TO OS (M)	EXPLOSION SOURCES
Railway tank-trucks (petrol) 120 m^3	260 (movable)	Vapours
Tanks for petrol storage (diesel oil), 5x2000 m^3	1700 (stationary, Yanov storage facility (above-ground)	Vapours
Tanks for petrol storage (diesel oil), 2x780 m^3	1700 (stationary, Yanov storage facility (above-ground)	Vapours
Tank-truck with trailer (petrol) 15t (20 m^3)	400 (movable, motor road on the South)	Vapours
Motor-vehicle to carry cylinders with acetylene, propane/butane	400 (movable, motor road on the South)	acetylene, propane/butane
Gas receivers for hydrogen: 15 cylinders with volume 20 m^3, P=9,5 kgf/cm^2	700 (stationary building 21)	Gas hydrogen

The maximum load value of the tank – truck explosion on motor road (external explosion) constitutes 2363.68 Pa (240 kgf/m^2). This value exceeds the load from the extreme wind, thus, it is necessary for SSE ChNPP to perform the organisational and technical measures to reduce the explosive danger sources.

There are no routes for landing approach for airplanes within the boundaries of the Exclusion Zone; there are no airports or military ranges there.

Masts for high-voltage lines are situated at standard safe distance; they are equipped with lightning conductors and grounding mats. Temporary storage of combustible materials I snot performed near the OS [4.3.4].

The Object Shelter is situated in the Western part of the ChNPP industrial zone. OS represents the ChNPP Unit, damaged by the “beyond design” accident, which lost all the operational functions of the power Unit and where the primary measures of eliminating the consequences of the accident have been performed and the works on nuclear and radiation safety provision go on.

The OS includes the following:

- Power Unit Б of ChNPP, II commissioning stage, damaged by accident, with separating walls from side of Block В, within Axes 39-41 and from side of Block Г within the Rows В-Г and Axes 39-52;
- Facilities, erected around the damaged Unit 4, including the floors above the Central Hall, Deaerator Stack and Turbine hall;
- Part of NIAS Block В of the ChNPP, II commissioning stage, limited by the Separating wall in Rows Г-Т and Axes 39-41;
- Part of ASRU block in Rows У-Ю and Axes 41-44;
- Part of Block Г in Rows А-Б against the separating wall along Axis 34 to Axis 68;

- Part of Block Г in Rows Б-В and Axes 37-68;
- Territory inside the perimeter of the fenced-off area equipped with monitoring and supervision devices (Local zone);
- Constructions, systems and elements, meant for maintaining the activity authorized at OS, with provision for safety during its operation [4.3.1].

The territory, adjacent to the OS is divided into:

- The OS Local zone;
- OS Industrial site.

The Local zone – part of OS, adjoining directly to ChNPP Unit4 (280 m x 320 m), equipped with physical protection means and specially secured.

The Local zone is detached from the surrounding territory by the existing double fencing. The internal fence is made of reinforced concrete; the external one is reticular, adjacent to the ChNPP fencing from the West and from the East – to the Main Body. From the Western part the Local zone is limited by the reinforced fencing.

Entrance for the personnel to the Local zone is permitted through KPP 4, passage for motor transport – through KPP 5.

Some temporary constructions provided within the OS operation are located at the Local zone; permanent structures are absent (Figure A3.1-2).

Operative and non-operative observation bore-holes are present in the Local zone. There are geodetic points GPS-14 and GPS-15 directly at Western Local zone fencing and GPS-16 which is located nearby Southern fencing. 4 lighting masts are installed at axis 80+5,0m row C+3,0m and axis 60 row M'.

OS Industrial site is adjacent to the Western part of the Local zone and situated inside the ChNPP area of physical protection (Figure A3.1-2). OS Industrial zone is a site fenced within protected perimeter of dimensions ~440 m (from North to South) and ~345 m (from East to West). Double fencing is laid along the perimeter of OS industrial zone: external –reinforced concrete and internal - reticular, joining the ChNPP fencing from the external part.

Construction site for pre-assembling and sliding the NSC will be arranged on the industrial site and OS local zone. For NSC arch installation at the distance of 180 m away from the design position of Western NSC end wall, a site of 98 m x 300 m will be arranged; it will serve for arranging a concrete site of 300 m x 67,5 m x 0,5 m (including scaffolds, stages, crane equipment or hoist-lifting).

The Industrial site is divided into conditionally “clean” and conditionally “dirty” zones. The conditionally “clean” zone comprises of conditionally “clean” zone BK-3 change facility, guard house, complex of Administrative Technological Building of the OS Technological Maintenance Shop, Training Centre building, unheated warehouse, mock-up area and is separated from the rest of the area by reticular fencing.

In the SIP frame, the jobs addressed to realization of the Physical Protection System project are implemented in the Local zone and the Industrial site [5.3.51].

Around the industrial site and inside the OS Local zone at Northern and Southern areas of physical protection system, they will install reticular double rowed fencing of 2.2 m height with peak of cutting belt «CONCERTINO», laying in three lines on the external fencing and with peak cutting line on the internal fencing. Western part of fencing of the Local zone and check-points KPP-4 and KPP-5, which are served for access of personnel and transport, will be dismantled.

Twin-row, reinforced concrete and reticular fencing will be installed around the perimeter of the OS Industrial zone (350 m x 450 m) along Southern, Northern and Western zones. At the places where the OS industrial site adjoins the ChNPP fencing, the reconstruction of KPP-13 KPP-14 and KPP-16 will be performed. All KPPs will be equipped with joist linear collision-resistance gates and KPP-16, additionally, with collision-resistance facility.

On the OS roof surface, three rows of “CONCERTINO” cutting belts and detectors are placed. Such a barrier has individual configuration for each section which depends on the state of the roof.

Within the SIP framework, project “Design and Construction of the Off-site Utilities and Associated Facilities” has been realized [5.3.4].

OS Off-site Utilities includes:

- Household potable water supply;
- Fire- water supply;
- Industrial water supply;
- Heating supply;
- Sewage of household-residential discharge;
- Sewage of industrial and storm discharge;
- Special sewage;
- Electric power supply;
- Communications;
- Management.

Layout of Off-site Utilities (heating network with water piping, sewage, special sewage and cable trays of the power network and management systems, alarm systems and communications) is foreseen at:

- Low supports (0.5 to 1.2 m);
- Underground – in impassable channels, in the cross-pass places ;
- Overhead – on high supports with height of 6.5 m, above the existing approach railways.

External – sites engineering communications have been designed in form of above ground layout of the overpass, carried out on low supports.

Household potable water supply is provided from AEWRPS-III. Pipelines have been designed as Du 50-200 mm.

The characteristics of the water supply for industrial and household potable needs are set forth in section 3.6.2.6 of CDSD.

The fire water supply to OS industrial zone is provided by fire hydrants installed on the fire water net. The water supply to the fire extinguishing system is carried out using pumps laid down in BPS-4, 5; pipelines are manufactured of steel welded pipes Du 100-400 mm.

Water characteristics of the fire-protective water supply are set forth in 3.6.2.6 of this CDSD.

Heating supply to the OS industrial site is provided using the existing heating system Du500 pipes of the ChNPP industrial site. Hot water supply for consumer needs is received directly from the heating system supplying pipeline. After the mixing unit, it is supplied to the hot water supply system. The system has been designed with pipelines made of welded steel pipes Du150.

Water characteristics of the fire-protective water supply are presented in Section 3.6.2.6 of CDSD.

For OS water users, the self-contained consumer sewage system has been designed. Discharges, delivered into SPS-1 site under pressure mode, are accumulated in the receiving tank of the Pump Station 1; they are to be pumped evenly into sewage disposal plants round-the-clock. The pipelines are made of welded steel pipes Du100.

Within Small Stroybaza and the ChNPP industrial site are the objects of drainage into the sewage of industrial-storm discharge. The system has been designed with pipelines made of welded steel pipes Du 150-300 mm.

Characteristics and criteria of LRAW are set forth in Section 2.8.3 of this document.

Interaction of NSC CS-1 communications with ChNPP and OS communications are described in section 3.6 of this document.

The associated OS facilities (AF) include:

- Automatic elevating water running pump station III water (AEWRPS III);
- Combined administrative building (CAB);
- OS sewage treating facilities (OS STF);
- Sewage pump station for residential waste waters No1 (SPS-1);
- Local sewage plants for industrial and rain drainage of OS industrial site (OS LSP);
- Local sewage plants for industrial and storm discharges of Small Stroybaza (LSP);
- Indoor switchgear of 6 kV кВ (ZRU-6 kV) with administrative-technical building (ATB).

CAB is situated in parallel with access road for OS AB; there is an overpass to the South of the CAB building (at distance of 8 - 18 m).

Building of AEWRPS III is situated at 53 m to the South-East from the existing highway and at 43 m against the overpass, stretching in parallel to the highway. SPS No 1 Site is situated at 70 m against the existing ring road.

From the North, OS LSP joins directly to the fencing of the designing site ZRU-6 kV and ATB, but the Eastern side of fencing is situated in cross-section, from the Eastern side of ZRU site fencing.

The OS LSP site for storm sewage of Small Stroybaza is situated in parallel to the Western side of the Small Stroybaza fencing at 45 m from it and at 25 m in parallel to the existing highway.

The OS STF site from the Eastern side joins the fencing of the existing sewage disposal plants, but from the Northern and Southern sides it is situated between two existing highways.

KTP 6/0.4 kV plant is Installed inside the ZRU-6 kV with 2x160 kV·A transformers. RU-6 kV is located in room 8 of the facility No5. RU-6 kV is connected to ChNPP power Units No 2, 3 by two cable lines, each of which consists of 4 cables VVG ng-3x240.

OS sites and facilities are provided with roads covered with cement-concrete coating. These allow connections with the roads of the Exclusion Zone.

To deliver the goods to ChNPP by motor transport, the main transport communications are:

- Main traffic artery Kiev-Chernigov;
- Roads with asphalt coating which connect Kiev, Chernobyl and Chernigov; Slavutich and Chernobyl;
- Roads of the Exclusion Zone.

For freight delivery by railway transport there are the following:

- Yanov railway station, situated at 2km to the West of OS industrial site;
- Railways of the Exclusion Zone.

The water way allows transportation of goods from Kiev to Chernobyl by the Dnieper, via Kiev reservoir to the existing port on the Pripyat River. There are restrictions in height, caused by the presence of a bridge, at fairway from Kiev-port till entry to Pripyat River [5.1.1].

To deliver the personnel, implementing the works at the OS, the routes for transport are:

- Electric train from Slavutich to Semykhody station;
- Buses from Semykhody station to the construction site;
- Buses from Kiev to Chernobyl;
- Buses from Chernobyl to the construction sites.

The presented information is insufficient for determination of transportation schemes of freight delivery, storage sites selection, etc. Section 3.9 presents the list of information to be provided by the Employer prior to the start of the design.

3.2 TEMPERATURE AND HUMIDITY IN THE SHELTER ROOMS

Microclimate inside the OS is supported only in separate rooms of Unit Г and NIAS. In the rest of Unit Б, DS and Turbine Hall rooms, the temperature and moisture mode depends on meteorological conditions of the environment and is subject to the seasonal changes of temperature and atmospheric air moisture.

According to many years of observations, the average summer temperature inside OS is approximately by 5 ^{0}C lower, and the winter temperature is by 5 ^{0}C degrees higher than the one in the atmosphere.

The range of air humidity values in the OS rooms is high for any season, nevertheless one can make conclusion, that the most stable situation in OS is observed during summertime (range of values in all the monitored rooms is practically constant). The same situation, with a greater range of values, is observed for the autumn season as well. The air humidity inside OS during winter and spring seasons changes significantly from room to room. The minimum values of air humidity inside OS are reached during the winter-spring period, and the maximum during the summer-autumn period.

Tables 3.2-1 and 3.2-2 provide data on relative humidity and temperature in some OS rooms, obtained according to the monitoring results in 2003. Humidity values in the indicated period were in the range from 21% to 83%, the temperature changed in the range from 3^{o}C to +24^{o}C [4.5.6].

Table 3.2-1. Air humidity values in the OS rooms in 2003

NO	DESCRIPTION OF MONITORING POINT	AIR HUMIDITY VALUE, %							
		WINTER		SPRING		SUMMER		AUTUMN	
		AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE
1	Door to Room 553/2	40	21-56	56	29-82	71	60-81	62	45-78
2	Stair 059/2 door at elev. +16.500	40	16-61	57	31-83	66	50-82	63	48-79
3	Stair 059/2 at elev. +16.500	34	13-55	53	30-76	72	54-90	68	58-78
4	Passage to Room 502/2	42	17-66	54	31-77	67	48-85	64	48-79
5	Door to lobby of Room 615/2	40	20-60	59	33-85	68	48-83	63	45-80
6	Lobby in front of «Dositheus» stair at elev.+24.000	44	21-66	63	42-83	66	46-86	62	41-82
7	Door to Room 403/3	38	21-54	62	38-86	68	48-87	64	45-83
8	Door to Room 402/3	51	30-72	62	38-86	66	48-84	64	45-83
9	Middle of «Dositheus» stair at elev. +18.000	49	25-72	60	40-80	69	51-87	65	47-83
10	Door to Room 406/2	46	19-72	61	41-80	72	59-84	70	57-80

NO	DESCRIPTION OF MONITORING POINT	AIR HUMIDITY VALUE, %							
		WINTER		SPRING		SUMMER		AUTUMN	
		AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE
11	Lobby in front of Room .318/2	46	20-72	61	41-80	73	62-84	66	49-82
12	Lobby in front of Room 405/2	40	20-72	61	41-81	74	63-84	61	47-74
13	Door to Room 318/2	46	19-72	64	29-86	77	68-83	62	42-84
14	Door to Room 308	46	19-72	61	41-80	74	63-84	65	47-82
15	Door to Room635/4	44	28-60	57	32-82	65	46-83	64	48-79
16	Entrance to stair 059/2 at elev. +10.000	42	14-69	60	31-88	71	59-82	66	53-78
17	Passage from stair 059/2 to corridor 401/2	44	14-73	66	39-93	66	52-80	69	56-81
18	Opening to the stair, filled with concrete before Room.401/	37	14-60	66	39-93	70	56-83	69	59-79
19	Door of Room 401/2	58	14-73	46	23-60	70	57-82	63	47-82
20	Door from Room 401/2 behind buttress wall	46	15-76	64	40-87	72	56-88	69	58-79
21	Door from Room 401/2 into Room 427/2	46	15-76	64	40-87	72	56-88	70	58-82
22	Door from stair 059/2 into Room Г-262/2	52	22-82	68	51-84	73	54-91	68	55-80
23	Corridor 206/2, in front of Room 207/4	52	29-75	64	50-78	73	55-90	68	56-80
24	Corridor 206. hatch into corridor 006	53	33-72	52	38-65	67	51-83	68	58-77
25	Entrance from Room .207/4 into Room 210	38	15-60	46	17-74	58	44-72	57	39-75
26	Door to Room 207/4 from corridor .206/2	51	33-69	56	38-74	66	51-80	68	58-77
27	Entrance from Room .206/2 into Room 207/5	32	17-46	37	16-58	47	33-60	35	10-60
28	Entrance from 207/4 into Room 208/10	39	18-60	37	17-57	49	27-70	51	39-63
29	Stair at elev.+16.000, entrance into Room 555	56	26-82	44	26-61	71	58-82	59	42-77
OS (all points)		45	21-68	57	35-79	68	53-83	64	49-79
Atmospheric conditions		81	62-100	73	49-97	69	41-96	88	75-100

Table 3.2-2. Air temperature values in the OS rooms in 2003

NO	DESCRIPTION OF MONITORING POINT	AIR TEMPERATURE VALUE, ^{O}C							
		WINTER		SPRING		SUMMER		AUTUMN	
		AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE
1	Door in Room 553/2	12	8-15	17	12-21	22	19-24	17	15-18
2	Stair 059/2 door at elev. +16.500	10	6-14	16	10-21	21	18-24	15	12-18
3	Stair 059/2 at elev.+16.500	12	8-16	16	11-20	20	18-22	15	11-18
4	Passage to Room 502/2	10	6-14	15	10-20	21	18-23	16	13-18
5	Door into lobby of Room 615/2	9	5-13	15	9-21	20	17-23	16	12-19
6	Lobby in front of “Dositheus” stair at elev. +24.000	5	-0,1-10	11	6-15	20	17-22	14	11-17
7	Door in Room 403/3	5	-0,1-9	12	7-17	19	16-22	15	11-18
8	Door in Room 402/3	5	-0,1-9	12	6-17	19	16-21	15	11-18
9	Middle of «Dositheus» stair at elev. +18.000	4	-2-10	11	6-16	18	15-20	14	10-18
10	Door in Room 406/2	6	2-10	10	5-14	16	14-20	14	10-18
11	Lobby in front of Room 318/2	7	2-12	10	5-14	16	14-20	13	8-18
12	Lobby in front of Room 405/2	8	2-13	10	5-14	16	14-20	13	8-18
13	Door in Room 318/2	7	2-12	10	5-14	16	14-20	13	8-18
14	Door in Room 308	7	2-12	10	5-14	16	14-20	13	8-18
15	Door in Room 635/4	10	6-13	15	9-21	19	17-24	16	11-21
16	Entrance to stair 059/2 at elev. +10.000	8	1-15	13	8-18	20	16-24	15	10-20
17	Passage from stair 059/2 into corridor 401/2	7	1-13	12	7-17	20	17-22	14	11-17
18	Opening to the stair, filled with concrete in front of Room 401/	8	1-14	12	7-17	19	16-22	13	9-17
19	Door of Room 401/2	8	1-15	11	5-17	19	16-22	14	10-18
20	Door from Room 401/2 behind buttress wall	5	-4-13	9	1-16	18	15-20	13	8-18
21	Door from Room 401/2 into Room 427/2	5	-4-13	9	1-16	18	15-20	13	8-18
22	Door from stair 059/2 into Room Г-262/2	4	-3-10	11	4-18	18	15-20	14	9-19
23	Corridor 206/2, in front of Room 207/4	4	-3-10	13	5-20	18	15-21	14	9-18

NO	DESCRIPTION OF MONITORING POINT	AIR TEMPERATURE VALUE, °C							
		WINTER		SPRING		SUMMER		AUTUMN	
		AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE
24	Corridor 206, hatch into corridor 006	7	1-12	15	8-22	20	17-22	15	10-19
25	Entrance from Room 207/4 into Room 210	14	8-20	16	8-24	29	19-39	22	17-26
26	Entrance to Room 207/4 from corridor 206/2	10	3-16	15	8-22	21	18-23	15	10-20
27	Entrance from Room 206/2 into Room 207/5	14	7-20	19	8-30	29	25-32	21	16-25
28	Entrance from Room 207/4 into Room 208/10	19	9-29	17	8-26	31	22-40	21	16-26
29	Stair at elev.+16.000, entrance to Room 555	14	10-17	17	13-21	20	17-23	21	15-26
OS (all points)		9	3-14	13	7-19	21	17-24	16	11-20
Atmospheric conditions		-10	-20,7-0,6	11	-3,4-24,1	18	11,2-23,8	7	-1,5-15,3

The analysis of the temperature in OS rooms shows that the temperature inside OS changes significantly during the winter-spring period but has sufficiently stable values during summer-autumn period. The same is true for the air humidity. This situation is caused by availability of man-made heat sources, whose operation leads to a higher temperature gradient inside the OS (15-20 °C).

The heat sources in the rooms of Unit Г are:

- Heat supply registers;
- Input ventilation radiators;
- Heating devices.

The heat sources in the rooms of Unit Б are:

- FCM accumulations;
- Heating devices.

The temperature in rooms of FCM accumulations changes in ranges from +5°C - +10°C (over FCM in Rooms 305/2 and 210/6) and +20°C - +30°C (under FCM in Room 305/2).

Heat supply registers are installed in rooms of Deaerator Stack at elev. +5.800, +10.000, +16.400, +19.500 and +24.270.

Radiators of input ventilation systems 4П-1 - 4П-6 are designed for heating of the following rooms of the Deaerator Stack:

- 4П-1 – for Sewage-Pump Station of special sewage and Sewage-pump station of sanitary sewage at elevation +1.000;
- 4П-2 – for decontamination section of small equipment at elevation +1.000;

- 4П-3 and 4П-4 – for rooms of sanitary lock at elevations +5.800;
- 4П-5 – for rooms of pneumosuits washing (at elevation +5.800) and washing PPE (at elevation +1.000);
- 4П-6 – for rooms of Heat-Mechanical Equipment section at elevation +5.800.

Supply and exhaust ventilation VP-9 in Room 515/3 is turned on only during performance of drilling activities in this room, but no such works were performed in the past years.

Heating devices are installed in Rooms Г-114/1, Г-102/3, Г-107, Г-274, Г-351, Г-360, 3.8, Г-632, 002/2, 207/4, 206/2, 208/10 and 401/2.

The greatest humidity values and the lowest temperature values are observed during summer-autumn period in Rooms of Unit Б, located at bottom elevations. Rapid increase of humidity in these rooms occurs during March-May, when the temperature in sub-roofing space becomes positive and intense melting of snow and ice, accumulated during winter period, begins. Humidity increases even more during May-September, when the temperature inside OS is lower than outside, which leads to generation of condensate.

During the wet period (May-October), when the values of humidity and temperature of atmospheric air are higher than humidity and temperature of structures at bottom elevations of the Unit, up to 340 t of moisture can be generated as a result of condensation [5.1.10].

During October-April period, when the humidity and temperature values of atmospheric air are lower than the humidity and temperature inside OS, the process of moisture evaporation dominates in the rooms. The amount of moisture able to evaporate during autumn-winter period is evaluated as 380 t.

The exact quantitative evaluation of the condensation moisture scope in rooms of the Shelter is practically unsolvable at the present time.

In 1999, in order to specify temperature induced deformations of OS structures, temperature changes of metal and reinforced concrete structures located under the OS roofing were monitored during a year (in the area of beams B1/B2 along Row Ж, axis 50), depending on change of the external air temperature (see Table 3.2-3) [4.5.3].

Table 3.2-3. Temperature values of metal and reinforced concrete structures under OS roofing during 1999 -2000

MONTH	TEMPERATURE PARAMETER	TEMPERATURE, ^{O}C			
		EXTERNAL AIR	INTERNAL AIR	METAL	CONCRETE
August	Average monthly	17,0	20,1	18,6	18,0
	Average daily, max	21,0	22,6	21,4	19,9
	Average daily, min	14,0	18,0	17,0	17,0
September	Average monthly	15,0	19,1	17,2	16,7
	Average daily, max	20,2	24,1	22,9	20,8
	Average daily, min	6,2	15,3	12,1	13,0
October	Average monthly	7,2	10,7	8,7	9,0
	Average daily, max	18,1	21,2	20,3	17,8
	Average daily, min	0,2	5,2	2,2	3,7
November	Average monthly	-0,7	-0,6	-0,8	1,4
	Average daily, max	8,7	8,7	8,7	7,9
	Average daily, min	-15,0	-15,0	-15,0	-5,2
December	Average monthly	-0,8	-0,8	-0,8	0,0
	Average daily, max	6,7	6,7	6,7	3,6
	Average daily, min	-7,8	-7,8	-7,8	-3,0
January	Average monthly	-4,4	-3,5	-3,6	-3,3
	Average daily, max	0,5	0,5	0,5	-0,8

MONTH	TEMPERATURE PARAMETER	TEMPERATURE, °C			
		EXTERNAL AIR	INTERNAL AIR	METAL	CONCRETE
	Average daily, min	-15,3	-11,7	-11,8	8,1
February	Average monthly	-0,7	-0,2	-0,4	-1,1
	Average daily, max	3,1	3,0	2,8	0,3
	Average daily, min	-6,6	-4,1	-4,3	-2,9
March	Average monthly	1,0	1,6	1,5	0,6
	Average daily, max	4,7	6,2	6,1	3,1
	Average daily, min	-2,6	-1,7	-1,9	-0,7
April	Average monthly	12,3	13,2	13,1	9,8
	Average daily Max	19,0	22,2	22,4	16,9
	Average daily Min	1,2	2,0	1,8	3,4
May	Average monthly	14,9	16,3	16,3	14,8
	Average daily, max	23,9	24,2	24,3	19,8
	Average daily, min	4,5	8,1	7,8	11,7
June	Average monthly	17,8	18,6	18,5	17,6
	Average daily, max	25,8	25,2	25,3	20,7
	Average daily, min	9,4	11,5	11,4	14,6
July	Average monthly	18,5	18,6	18,5	17,4
	Average daily, max	23,0	23,9	23,8	18,6
	Average daily, min	15,7	15,7	15,5	16,6

The input information on the temperature and humidity in the rooms is of long standing. However, it is sufficient for the design to begin. The implementation of the additional surveys, considering the seasonal fluctuations, will take at least a year and is deemed unreasonable. Besides, performance of such surveys will result in high dose loads of the personnel.

3.3 CONNECTIONS WITH EXISTING STRUCTURES

The NSC structure (arch) will enclose the OS localizing structure (OS LC), including part of the Turbine Hall and Deaerator Stack, part of Unit B, NIAS, southern and western pioneer walls, cascade wall. According to CD for NSC, the arch will rest upon new northern and southern foundations with 14 m width at Elevation +114.00 m BSA.

The NSC metal structure will have the following approximate sizes: 257 m width (North-South), 150 m long and height of external surface - 108.4 m, height of internal surface – 96.4 m from the plane of foundations, and 12 m height of arch cross-section [5.1.1]. Thus, it is required to minimize interactions between the NSC and the existing structures (for example, by creation of mobile interfaces, pendant face device and use of flexible casing between OS and NSC structures).

Consequently the NSC CD (FS) has stipulated that only two sites (southern and northern) of NSC eastern end wall will rest upon two newly built foundations (the southeast and northeast foundations at Elevation +124.00) and the central part of eastern face wall will be hanged on the arch and jointed by flexible casing to the OS structures (with roofs of Turbine Hall, DS, Unit B and NIAS).

For the western end wall, except southern and northern foundations, the NSC CD (FS) foresees that the central foundation will be the support of the frames for the end wall. The new Technological Building will serve as a boundary for the fencing structure in the western end wall, also as Turbine Hall and DR that will project out from NSC to the West from an Axis 64.

On the basis of decisions [5.1.1] for development of the detailed design on NSC SC-1 regarding communications of NSC with OS existent structures, the following initial data on concerned OS structures will be taken into account:

- Roof of Turbine Hall in Axes 39 and 64, in Rows А-Б;
- Roof of DS in Axes 39 and 64, in Rows Б-В;
- Roof of Unit B along Axis 39, in Rows Г-Т;
- Roof of NIAS along Axis 39, in Rows Ф-Ю;
- Ventilation stack (VS-2) base;
- Southern «pioneer» wall in Axes 41 and 50, in Rows Б-Г.

This list shall also include the existing underground communications and OS engineering networks that pass through the NSC foundations (at Elevations +111.380m and +110.360m) because undesirable influences from NSC casing to OS structures (vibration, pushes, resonant oscillations) can be transferred through contacts between OS underground communications and NSC pile foundations.

The preliminary analysis showed the necessity of significant excavations, concreting of existing unused communications and transfer of pipelines and electric cables [5.1.6]. At the detailed design stage it will be necessary to analyze existing engineering networks and communications, considering the specified data on NSC foundation arrangements, to define the scope for dismantling and excavation operations. Specific surveys and investigations shall be performed for that purpose.

Reports [5.3.20, 5.3.2] provide the general list of 67 passports of the structures responsible for OS safety.

The basic data concerning passports No. 1-61 are provided in report [5.3.20], and descriptions of six passports No. 62-67 are presented in report [5.3.21].

3.3.1 INITIAL DATA OF THE OS LOCALIZING CONSTRUCTION

The confinement facility of the Object Shelter consists of a combination of "old" (design) structures of the destroyed Power Unit 4 and "new" structures erected after the accident (figure 3.3-1).

As a consequence of the presence of these structures, a spatial facility was built whose structures perform extremely important function of a physical barrier on the release of radioactive substance and ionizing radiation into the environment.

Consequently, the confining function is the main safety function performed by the OS structures. Besides, the confinement facility restricts atmospheric impact on structures, process systems, accumulations of FCM and other radioactive waste located inside the OS.

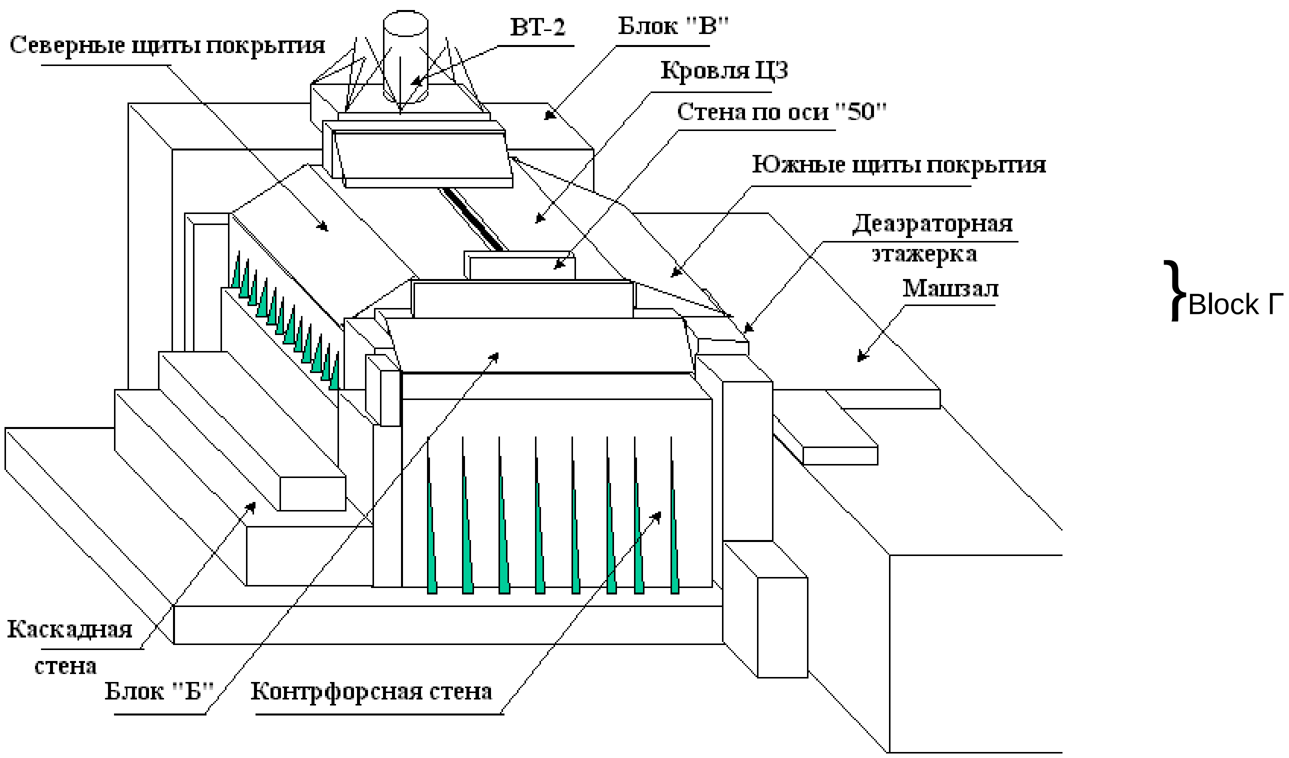


Figure 3.3-1. General Scheme of OS Building Structures

External enclosing structures erected after the accident make basis of the physical barriers: the Cascade wall, the Buttress walls, roofs of the Reactor unit, Deaerator Stack and Turbine hall.

Intact structures of Power Unit 4 create support contour for leaning of the roofing load-bearing elements over the Reactor unit and Deaerator Stack. Firstly these are the Northern and Southern exhaust shafts, the monolith wall along axis 50 with the framework adjoining to it. Main beams Б1 and Б2 lean on these structures and together with the pipe roofing create the roofing over central part of the Reactor unit (in particular, above the Central hall). The Mammoth and the Octopus beams lean on the Deaerator Stack structures.

Detailed description of the localizing facility and its structures is provided in the Shelter Safety Report (hereinafter OS SR).

Estimating the Shelter localizing facility as a whole it is necessary to take account of the following particular features of its structural scheme and technical condition:

- Support contour load-bearing structures (remained "old" (design) structures of Power Unit 4) and their connections are considerably damaged, overloaded with weight of debris of civil structures and equipment which collapsed upon them, as well as materials used during elimination of the accident. The bared reinforcement of reinforced concrete structures and steel structure are subject to corrosion processes;
- Reliability and service-life of load-bearing structures of the support contour cannot be accurately determined owing to non-availability of access to many elements and units, as well severe radiation conditions prohibiting performance of the detailed surveys;
- Non-closure of the support contour characterized by non-availability of ties in junction areas of individual parts – the contour is open on corners, it does not restrict any freedom degree in relation to horizontal deformations;
- "New" structures built after the accident are separated: they are not interconnected and freely lean on the load-bearing structures without physical connection and held in the design position at the expense friction forces (i.e. welding or bolted connections of the structures supporting are unavailable);
- Access to elements and components of steel structures for periodical examination and corrosion-resisting coating upgrade is complicated.

At present the OS including its localizing facility is operated according to the NPP maintenance schedule.

Taking into account that civil structures perform function of the physical barriers on paths of release of radioactive substances and ionizing radiation in the environment, the problem of their reliability and durability was and remains important to ensure nuclear and radiation safety of the Shelter object. Therefore, surveys of its civil structures condition and implementation of urgent measures on their stabilization started immediately after completion of the Shelter object construction.

Surveys and certification of the accessible rooms and identification of civil structures emergency condition areas influencing the Shelter overall stability and integrity were performed within 1987 – 1991. Three areas that require performance of immediate emergency works were identified: Deaerator Stack (Room 635/3), MCP motor room (Room 402/3), exhaust ventilation air duct room (Room 805/3).

At survey of the overhead tier of the Deaerator stack framework (between Axes Б- В /41 - 51) it was determined that columns between elevations +24,270 and +38,600 m deviated from the vertical line towards the Turbine hall for 700 - 1100 mm. Fractures with opening width of cracks about 150 mm appeared in column junction places at elevation approximately +24,300 m. The longitudinal principal reinforcement was broken, penetration of cracks in column cross-section added up to 0,6 - 0,9 m. Rigid connections of columns and girders were also destroyed which is confirmed by rupture of the overhead operating rebars of the tensile working area and shear of girders from supporting cantilevers at elevation +38,600 on 70 - 150 mm. Debris of civil structures, equipment and materials that was used during the accident mitigation, 3-5 m high appeared on the ceiling slab (above elevation +38,600)

Such condition of the Deaerator stack top tier framework structures was classified as the emergency. Severity of the situation was caused by the fact that the damaged columns along axis Б were overloaded at the expense roofing structures over the Turbine hall leaning on them. The column destruction would entail collapse of this roofing, as well as other steel structures of the Shelter Object southern part (the Octopus beams, southern panels-sticks). In case of more unfavourable development of the situation collapse of the Mammoth beam supports and

probability of subsequent collapse of roofing steel structures above the Central hall was not excluded.

Based on the data about condition of the Deaerator stack top tier framework structures, the overhead reinforced concrete columns of axis Б were fastened rapidly by means of sloped tie-rods consisting of two channels #16 welded to the concrete filled deaerator tanks. The struts consisting of two channels #24 for reinforcement of girder midspan at elevation +38,60 m were installed simultaneously.

Besides, in 1988 the trusses of the Turbine Hall roof leaning on the cantilevers of the columns of row Б (design solution of 1986) and instead of them the new roofing was assembled leaning on the steel-concrete walls newly erected in the Turbine hall between axes A – Б/41 & 49 was mounted instead of them.

After MCP motor room survey (Room 402/3) between Axes Г – Е/41÷50 it was established that the wall and columns along axis Г deviated towards axis В of the Deaerator Stack. At the supporting cantilever level (elevation +30,300 m) the columns displaced for 400 - 600 mm towards axis В. Breaks of the girder top rebars and considerable concrete split-offs were detected in rigid connections of girders and columns.

Condition of frame columns and ceiling slab (elevation +31,500) over Room 402⁄3 with MCP southern motors was also recognized as emergency. Reinforcement of the specified ceiling slab consisted in reinforcement of supporting areas of girders and was performed by putting the supporting steel structures under girders close to their leaning on the column cantilevers. The stabilization structures consisted of the load-bearing steel trusses combined in spatial units by system of horizontal and vertical ties, and later remotely slid over in design position by hoists along the bridge crane tracks.

A survey of the Shelter was performed after an earthquake in ChNPP area on May 30 and 31, 1990 with magnitude of 3,5 - 4 points and Shelter Survey Report was prepared that stated that there were no changes of positions and appreciable deterioration of condition of the main construction structures.

Particular features of the subsequent surveys arranged after 5 year operation of the localizing facility (during 1992 - 1997) were as follows:

- Expansion of survey scope (Additional survey of the Western zone load-bearing structures was performed: reinforced concrete wall along Axis 50 with adjoining framework and walls between Axes 49 – 51′, supporting joints of beam blocks Б1 and Б2 on the wall along Axis 50, protective and dividing walls and roofing steel structures, soils of basement, adjacent structures of Units В and NIAS);
- Complex approach (combination of field survey with probabilistic analysis and numerical modelling, with creation of physical models).

A number of the wall reinforced concrete leading defects was revealed by field investigations along axis 50 that have considerable effect not only on the load-bearing capacity and stability of the specified wall, but the Western zone on the whole as well and supporting joints of beam blocks Б1 and Б2 along axis Ж and П.

The wall top displacement close to supporting of Б1 and Б2 beam blocks (elevation +58,500 m) in relation to the wall bottom (elevation +12,500 m) is 500 - 700 mm close to axis П and about 1000 mm - close to axis Ж. The above position of the load-bearing wall was addressed during construction of the Shelter object; on the area supporting Б1 and Б2 beam block along axis 50/Ж the necessity occurred to arrange concrete support in non-removable load-bearing steel formwork. For some reasons design solutions on arrangement of such support (and simultaneous local reinforcement of the wall) were not implemented in full scope.

The actual parameters of the above steel formwork, conditions of its' leaning on debris of structures and on the wall along axis 50, as well as the filling degree by concrete were determined based on the results of the field surveys performed in 1993. Condition of Б1 and Б2 beam support block along axis 50 / Ж was recognized as unsatisfactory.

Reinforcement of the above support was performed in 1994 by putting steel stanchions under the bottom chords of Б1 and Б2 beam block rested against the concrete surface inside the "foundation". However implementation of this measure solved problem of increase of reliability of the support only partly. The necessity to perform more cardinal reinforcement in both the zones of Б1 and Б2 beam support block and all Western zone of reactor unit that includes the wall along axis 50 and reinforced concrete framework between axes 49-51' remained.

As a whole, per results of the survey conducted in 1992 - 1996, 29 localizing facility areas had been identified as requiring adequate measures on their stabilization. This group of unstable structures and structural components was included in the so-called «List of 29».

Hazard elimination related to VS-2 ventilation stack emergency condition was an important step in solving the problem to increase reliability of the structures which do not exert influence upon safety of the Shelter object.

Thirty defects were found when performing survey of elements and structural components of the ventilation stack load-bearing framework, namely: breakage of elements, inadmissible bend or loss of element stability, considerable corrosive damages, etc.

Repair of the ventilation stack load-bearing framework was made in 1998 with the assistance of experts of Ukraine, USA and Canada. Consequently, ventilation stack repair was the first international project that provided for the Shelter safety improvement.

As already stated, reinforcement of the supporting joints of Б1 and Б2 southern beam block along axis 50/Ж performed in 1994 did not provide for acceptable reliability level of this structural component. Besides, defects of supporting of northern unit of these beams along axis 50/П were determined.

Therefore, reinforcement of structural components of beams Б1 and Б2 along axis 50/ Ж and 50/П was performed in 1999 taking account of the reliability importance of this structural component on the Shelter object general safety. This reinforcement included welding of additional supporting elements for more reliable supporting of Б1 and Б2 beam blocks on the wall, as well as reinforcement of the wall by concreting its top.

Along with, it became obvious that any local reinforcement of Б1 and Б1 beam block supports do not solve on the whole the problem of reliability of roofing over the destroyed reactor unit. This is because the entire Shelter Western zone that includes the wall along axis 50 and framework along axes 49-51' has considerable damages (through breaches in the wall, cracks, horizontal displacement to 1000 mm) and is in unstable condition. The critical factor is seismic impact with the magnitude exceeding 4 according to MSK 64 scale.

Destruction of the above zone will result in collapse of the heavy pipe roof, its falling on the Central hall debris and the structures localizing fuel-containing materials (FCM). It can provoke FCM displacement, change of their geometry and, as a consequence, probability of occurrence of nuclear incident at water ingress is not excluded. Destruction of civil structures will be accompanied by volley release of radioactive substances located inside the Shelter object.

Taking into account the quantity of radioactive dust which lies on the surface of the debris inside the SO that is estimated by value about 4 tons, volley release total activity can reach 4 TBq under unfavourable conditions. It exceeds in more than 150 thousand times the authorised daily average release from the OS under normal operation conditions.

In case of such scenario, the personnel staying close to the OS during this time will undergo considerable radiation exposure. Moreover, the inhalation intake of radionuclides will be the

major impact factor. According to the current assessments, individual dose received within the time required to move the personnel in radiation-protection shelter can reach approximately 2300 mSv, that exceeds the limit of annual personnel dose in over 100 times.

Within the range 0,3-4 kBq/m^2 the area with the total area of about 400 sq. kilometres will be the subject to additional surface radioactive contamination.

Consequently, the Western zone stabilization is required to prevent the possible nuclear incident and considerable radiation consequences for the personnel and environment.

Despite the measures performed in 1988-1989 for stabilization of the top tier of the Deaerator stack framework, condition of the damaged columns was not stable which is confirmed by measurement data of their deformations.

Radiation consequences of the Deaerator stack structures possible destruction are stipulated by opening of the facility with the area up to 2500 m^2 and release of significant amount of radioactive dust.

Western zone and Deaerator Stack framework stabilization shall be performed irrespective of structure and terms of construction of the New Safe Confinement (NSC). This is connected to the possibility if unstable structures collapse, then after construction of NSC practically all radioactive dust remains within the protective enclosures that entails considerable contamination of confinement inner surfaces and the process equipment. It makes impossible to perform the confinement functions without decontamination and other measures to eliminate consequences of this accident that entails considerable dose uptakes that can exceed personnel collective dose at implementation of stabilization measures.

Surveys of the Mammoth beam supports found out critical defects influencing parameters of their reliability under extreme seismic impact. Position of the Western support mismatches the design in particular (the support is turned on 180°, load from the Mammoth beam is transferred to the support with considerable eccentricity). Concreted debris made of crushed stone and fragments of the destroyed structures with considerable hollows detected is the Eastern support basis.

Insufficient reliability indices of panels and "panels-hockey sticks" are accounted by non-availability of welded or bolted connections with load-bearing structures and interconnections that do not provide for integrity of protective enclosure under extreme wind and seismic loads.

More detailed analysis of results of the earlier performed investigations of civil structures and implemented measures for their stabilization is provided in OS Safety report.

In order to define the boundary parameters of deconstruction Table 3.3-1 presents the features of localizing facility aimed at determination of geometrical sizes of deconstruction sites, loads of crane equipment, etc.

Table 3.3-1. Characteristics of the elements of the localising facility

STRUCTURE	QUANTITY	MASS OF EACH ELEMENT, (t)	LENGTH (m)	WIDTH (m)	HEIGHT (m)	GENERAL WEIGHT (t)
Southern panels of roofing (between Axes 44 and 50)	6	31	28.7	6	1.3	186
Southern panels of roofing (between Axes 41 and 44)	6	16 (estimate)	28.7	3	1.3	96

STRUCTURE	QUANTITY	MASS OF EACH ELEMENT, (t)	LENGTH (m)	WIDTH (m)	HEIGHT (m)	GENERAL WEIGHT (t)
Southern hockey sticks	12	38	25.5	6	12.25	456
Mammoth Beam	1	127	70	1.5	5.5	127
Northern Beam Б1	1	65	55	1.6	3.2	65
Southern Beam Б1	1	65	55	1.6	3.2	65
Northern hockey sticks	18	9	18	3	10.5	162
Eastern hockey sticks	1	7.25	7	5.6	6.37	7.25
Western hockey sticks	4	20	15.5	8	8.5	80
Beams К1, К2 (С-Д/51′)	2	35.13	64.0	1.5	0.75	70.26
Light roofing	6	21	36	6.6	2.5	126
Pipe roofing (D=1220mm, δ=15.2 mm)	27	20 [5.1.15] 28 [5.3.5]	34.5	1.4	1.5	540
Northern Beam Б2	1	57	40	1.6	3.4	57
Southern Beam Б2	1	57	40	1.6	3.4	57
Beam Б3 (Ж-П/41)	1	17	35	2.0	1.30	17
Beam Б5 (Ж-П/43)	1	16	27.94	2.0	1.30	16

In order to consider the potential effects on the structures when creating the foundations, pile drilling, etc. the permissible limitations of dynamic power effects on the individual structures, foundations and bases of OS shall be taken into account. Tables 3.3-2 and 3.3-3 present these data.

Table 3.3-2. Permissible values of vibration velocity for OS structures of 1 and 2 groups

GROUP	DAMAGE NATURE	FREQUENCY, Hz	PERMISSIBLE VELOCITY, mm/s
1	Destroyed structures, significant deviations from vertical (wall along Axis 50, framework in Axes 49-51´, Deaerator Stack Framework, ventilation shaft)	10 10-20 20-40 40-100	1,0 2,0 4,0 10,0
2	Walls with cracks (separating wall between Unit B and OS, Northern cascade and buttress walls)	10 10-20 20-40 40-100	2,0 4,0 10,0 15,0

Table 3.3-3. Permissible values of vibration velocity for structures and foundations of NIAS and OS

Structure	Frequencies of dynamic effects, Hz	Permissible values of vibration velocity not more than, mm/sec
First group of structures		
Reinforced iron structures of western framework In Axes 49-51´ Rows Г-Д	1-10 10-20 20-40 40-100	1,0 1,0-2,0 2,0-4,0 4,0-10,0
	Experiments values of decrements of vibrations of reinforced iron structures equal to 0.22-0.26	
Wall along Axis 50 Rows Ж and П (supports of Beams Б1 and Б2)	1-10 10-20 20-40 40-100	1,0 1,0-2,0 2,0-4,0 4,0-10,0
Northern ventilation shaft in Axes 42-44, Rows Н-С Southern ventilation shaft in Axes 42-44, Rows Д-И	1-10 10-20 20-40 40-100	1,0 1,0-2,0 2,0-4,0 4,0-10,0
Deaerator Stack framework in Axes 41-51´, Rows Б-В	1-10 10-20 20-40 40-100	1,0 1,0-2,0 2,0-4,0 4,0-10,0
	Experiments values of decrements of vibrations of reinforced iron structures of Deaerator Stack equal to 0.24-0.28	
Second group of structures		
Northern Buttress wall in Axes 41-51´, Rows С-Т, wall base Elev. + 41.790, top of wall, Elev. + 54.600.	1-10 10-20 20-40 40-100	2,0 4,0 10,0 15,0
Northern cascade wall in Axes41-51´, Rows С-Ю	1-10 10-20 20-40 40-100	2,0 4,0 10,0 15,0
Separating wall between Unit «В» and OS along Axis 41	1-10 10-20 20-40 40-100	2,0 2,0-4,0 4,0-10,0 10,0-15,0
Foundations and bases		
Foundations of NIAS and OS	1-10 10-20 20-40 40-100	1,0 1,0-2,0 2,0-4,0 4,0-10,0

Diagrams and drawings of some internal and external OS structures are presented in Figures A3.6-1 - A3.6-22 in Attachment to this chapter.

3.3.2 COMMUNICATIONS WITH OS STRUCTURES IN ZONES OF NSC ENVELOP ABUTMENT

3.3.2.1 Data on building structures in zones of NSC envelop abutment

Figure 3.3-5 represents the scheme of NSC envelop abutment to OS existent structures (by dashed lines).

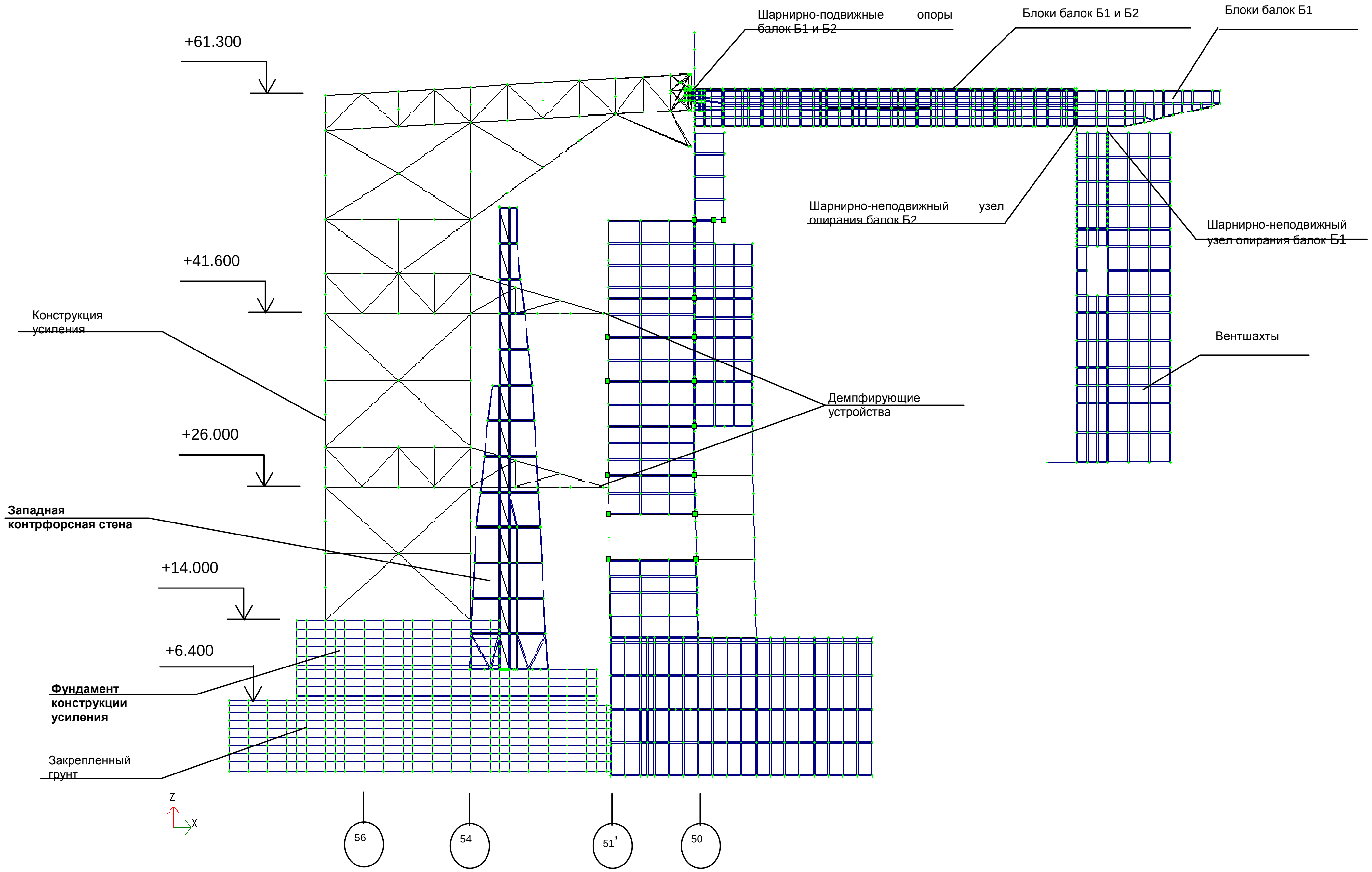


Figure 3.3-2. View of MSS computer model from Row B (stabilization measure 2)

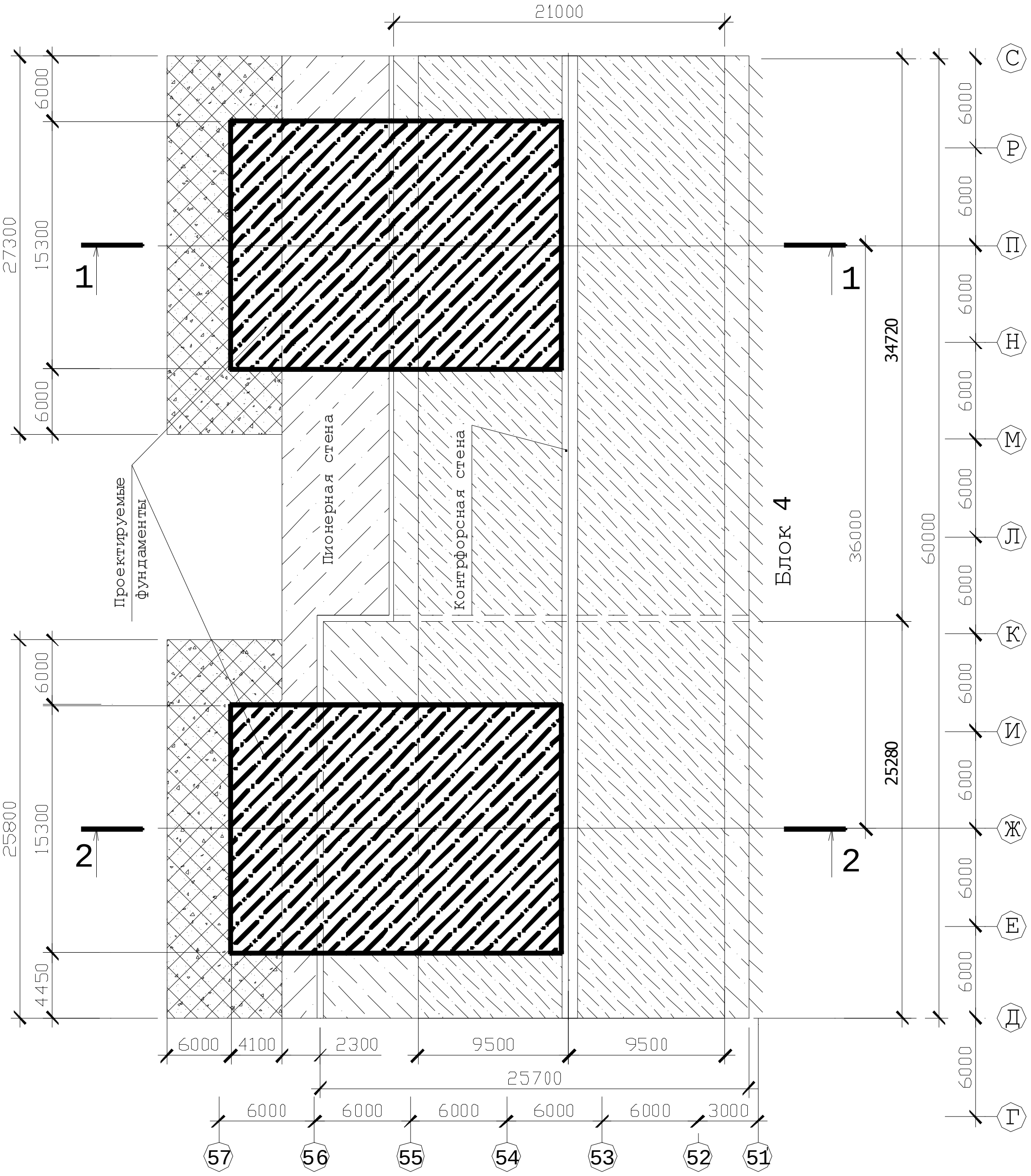


Figure 3.3-3. Layout of Constructed Foundations (FM-1 and FM-2) for MSS (Stabilization Measure 2)

Figure 3.3-4. Western zone: MSS structure (stabilization measure №2)

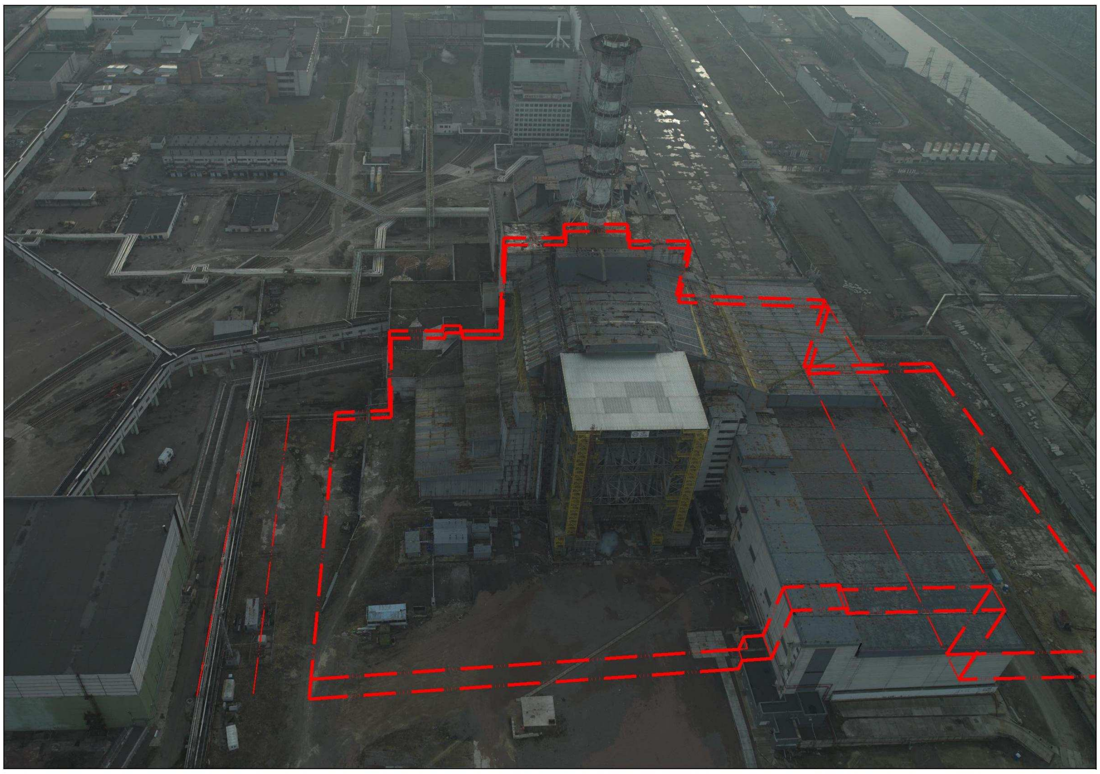


Figure 3.3-5. Scheme of OS abutment to existent structures in zones of NSC envelop junction (dotted lines)

Table 3.3-4. Characteristic of OS structures in zones of NSC envelop abutment

#	LOCATION		STRUCTURE
	ROWS	ELEVATION	
1	А-Б	+12,500	Turbine Hall floor
2	Б-В В-Г	от +54,360 до +60,870	Southern panels – hockey sticks roofing
3	Г-И	+72,010	Unit B roofing
4	И-Н	+75,200	Unit B roofing (base of VS-2)
5	Н-Т	+68,500	Unit B roofing
6	Т-У	+44,200	Top of northern cascade wall
7	У-Ф	+33,600	Northern cascade wall
8	Ф-Ю	+22,970	NIAS Unit roofing

3.3.2.2 Values of LC OS structures deformations and displacement

Within SIP, tasks model calculations of OS unstable structures were executed in view of usual and extreme impacts (for example, [5.3.20, 5.3.21]), whereas table 3.3-4 provides the list of stable structures and sites. Nevertheless, results of these calculations are useful preliminary initial data to estimate range of OS structures.

The analysis of computer models' calculation results [5.3.20] demonstrates that seismic and temperature impacts can be a reason for deformations and movement close to the limit in elements of unstable structures. As a result, only local destructions of elements of structures can take place. Such deformations cannot be allowed, therefore constant monitoring is required.

By results of calculation on building structures of static, wind, temperature and seismic impacts of 4-point earthquake controlled nominal (design) parameters were determined according to SNiP requirements [2.7-2.10] (including the constructions of the nuclear power plant).

Values of design parameters (deformations, displacements) of LC OS at Δt=60°C and 4-point seismic impacts for diagnosing zones are provided in table 3.3-5.

Indicating nominal parameters the temperature range is accepted from -30 °C to +30 °C.

Maximum allowable (limit) parameters were determined as a result of calculations of structures on extreme wind impacts and 6-point seismic loads.

The absolute maximum temperature +45°C and absolute minimum temperature -45°C were accepted for calculations in the process of structure control parameters definition at extreme temperature impacts.

Table 3.3-5. Nominal (design) values of deformations and displacements of building structures

No	Name of diagnosing zone	Controlled parameters	
		Deformation, $\varepsilon \cdot 10^{5}$	Displacements along x, y, z, mm
1	Block of beams Б1 on Rows П and Ж	70-80	(35-40)*
2	Block of beams Б2 on Rows П and Ж	70-80	(25-30)*
3	Support of beams Б1 and Б2 on Row Ж	70-80	(10-15)*
4	Support of beams Б1 and Б2 on Row П	70-80	(8-14)*
5	Wall on Axis 50	—	(10-15)*
6	Beam "Mammoth" and supports	70-80	8-15
7	Framework in Axes 49-51 ' and Rows Г-Т	70-80	16-24
8	Framework of Deaerator Rack	-	10-15
9	Metal structures strengthening of Deaerator Rack	70-80	—
10	Contact zones between Deaerator Rack and Turbine hall	70-80	—
11	Metal structures of piping roof above the central hall	70-80	15-25
12	Northern and southern ventilation shafts	70-80	5-9
13	Metal structures strengthening in MSCP	70-80	—
14	Shields and "sticks" of covering in Rows П-Т and Axes 41-50	—	5-7
15	Shields and "sticks" of covering in Rows Б-В and Axes 40-52	—	5-10
16	Northern Buttress wall in Rows Т-С and axes 41-51 '	—	1-3
17	Beam "Octopus" and supports	70-80	12
18	Cascade wall	—	—
19	Separating wall between OS and Block B	—	2-5

**- from impact of temperature difference $\Delta t=60\,^{\circ}C$*

Structures deformations and displacements limit values at Δt=90°C and for 6-points seismic impacts are provided in table 3.3-6.

[5.3.20] contains the calculated models of block B developed static and seismic impacts calculations and comparison of obtained vibration frequency values with in-situ experiment data.

Maximum displacements of the top of block B construction (on Elevation +71.200) taking into account all deformation types caused by seismic impacts (bend, change of construction and pliability of foundation) of cantilever model in transversal direction («east-west») are:

- According to СНиП П-7-81 calculation method and calculation model №1 – 3,88 cm (on results of MO of AEP – 5,18 cm);
- At calculation at earthquakes accelerograms of horizontal bending in the top level 5,18 cm (for hard model of MO of AEP) and 7,9 cm – for flexible model №4A.

Table 3.3-6 – Maximal (limit) values of structures deformations and displacements

No	NAME OF DIAGNOSING ZONE	CONTROLLED PARAMETERS	
		DEFORMATION, $\varepsilon \cdot 10^{5}$	DISPLACEMENTS ALONG x, y, z, (mm)
1	Block of beams Б1 on Rows П and Ж	110-120	(45-50)*
2	Block of beams Б2 on Rows П and Ж	110-120	(40-45)*
3	Support of beams Б1 and Б2 on Row Ж	110-120	17-30
4	Support of beams Б1 and Б2 on Row П	110-120	(13-18)*
5	Wall on Axis 50	—	(45-50)*
6	Girder "Mammoth" and supports	110-120	20-40
7	Framework in Axes 49-51 ' and Rows Г-Т	110-120	35-75
8	Framework Deaerator Rack	110-120	30-50
9	Metal structures strengthening of Deaerator Rack	110-120	—
10	Zones of Deaerator Rack contact with Turbine hall	110-120	—
11	Metal structures of piping roof above the central hall	110-120	25-30
12	Northern and southern ventilation stack	110-120	12-24
13	Metal structures strengthening in MSCP	110-120	—
14	Shields and "sticks" of covering in Rows П-Т and Axes 41-50	—	15-22
15	Shields and "sticks" of covering in Rows Б-В and Axes 40-52	—	15-25
16	Northern Buttress wall in Rows Т-С and axes 41-51 '	—	4-12
17	Beam "Octopus" and supports	110-120	18-35
18	Cascade wall	—	—
19	Separating wall between OS and Block B	—	5-16

**- from impact of temperature $\Delta t=90°C$*

Data was obtained concerning Block B structural deflections in the East-West direction. On the basis of this data, analysis by use of "rigid" deformation models [5.3.20] and conditions that the vibration amplitudes of Blocks A and Б will not exceed 5-7 cm, it can be confirmed that dimensions of settlementary seam in average part of the building (10-15 cm) between Blocks B and A, B and Б will not provide impact of adjacent block structures during 7-points MDE.

Data concerning maximum (limit) structural deformations and displacements during extreme impacts presented in this section, demonstrated the dynamic characteristics of the most unstable OS structures do not exceed 8 cm.

3.3.3 INITIAL DATA ON VS-2

This section of the draft CDSD has been removed because irrelevant to the CDSD.

3.3.4 RESTRICTIONS FOR MECHANICAL IMPACT ON OS STRUCTURE

Impact of vibration and settlements on OS building structures depends on the technical state of the structures that have been damaged, and also the type of impact (static, dynamic, shock, etc.). Besides, at definition of admissible parameters of structural loading it is necessary to take into account the frequency range of vibration sources, character of extinction of soil oscillation amplitudes with distance from dynamic impact source and also the kind of loading that causes the basis settlements.

OS damaged building structures admissible levels of vibrations and settlements can be roughly established at this stage on the basis of analysis of requirements from the existent standards of Ukraine.

The analysis of data obtained in the process of previously performed work is important, including building structures' oscillations research. In-situ researches of OS structures' vibrations (in eastern, western, southern and northern zones) were carried out in 1993 – 2003.

Estimation of the maximum horizontal and vertical displacements of OS structures' foundations, constructive systems of stabilization and NSC were earlier performed during researches according to package "A" SIP, development of Work Design for unstable building structures stabilization and development of CD (FS) NSC.

Conservative criteria of admissible values of vibrospeed and vibroacceleration for the structures that have experienced damage or destruction, and also limit values of basis settlements in WEZ at NSC construction that are admissible for OS structures are formed in view of analysis of available data on parameters of OS building structures vibration, pressure distribution under the sole of foundation and settlements, requirements of Ukrainian and international standards.

3.3.5 CONSIDERATION OF CONDITIONS OF THE SUBSEQUENT FCM REMOVAL

In 2000 NAEGC "Energoatom" made P7 Pragmatic Decision on preliminary strategy for FCM removal and management of accompanying RAW [5.2.13]. The decision defined specific measures for monitoring ruined civil structures and FCM till FCM removal. In the mean time another open issue was put forward which is the justification of urgent selective FCM removal immediately after early deconstruction of unstable OS structures.

The Strategy for FCM management developed by ChNPP in 2005 [5.2.12], apart from deconstruction of unstable structures NSC design states that the NSC will provide essential technological room for installation of equipment and application of technologies for removal of FCM and accompanied RAW.

As no concept design of FCM removal has been performed until now, the impact of FCM removal to the NSC cannot be defined during the NSC-CS1 Design. NOVARKA states therefore that the lay down area which is 1700 m² fitted for deconstruction works will provide significant room for further FCM removal-related activities. In this area, the CS3 Contractor will be able to install any needed fragmentation cells, storage facilities and tool management workshops. This statement is an answer to the request from the Strategy.

At the end of the CS1 Design, NOVARKA will estimate the reached performance characteristics of the NSC considering the safety provisions which will have been implemented. These performance characteristics will have to be specified by ChNPP as Design and Operation criteria for the future CS3 Contractor.

3.4 RADIATION CONDITIONS WITHIN THE LIMITS OF OS LOCALIZING FACILITY

Radiation conditions inside the shelter result from a situation created by the random distribution of radioactive materials. The main types of radioactive material are nuclear fuel, FCM, radioactive dust and radioactively contaminated water.

Irradiated nuclear fuel inside OS can be found in the following forms:

- Core fragments that were, as assumed now, thrown out by the explosion of the Unit 4 upper floors, in particular the Central Hall;
- Fine-dispersed fuel (dust), hot fuel particles whose sizes vary from fractions of microns to hundredths of microns. These are practically observed in every room of the OS;
- Solidified lava-like fuel containing materials originated during the active phase of the accident under high temperature interaction with Unit structural materials;
- Dissolved compounds of uranium, plutonium, and americium. These originated as a result of the destruction of various fuel modifications affected by certain factors; water being the major one.

Below, summarised data is provided concerning radiation conditions within the OS localising facility. More detailed information is provided in [4.5.37].

The major types of radiation impact caused by FCM are γ-radiation, α- and β- and neutron radiation.

Presently, after decay of short-lived isotopes of fission products, the ^{137}Cs isotope contributes more than 90% to the measured dose exposure values. $^{238-240}$Pu isotopes contribute significantly to α-activity, whose activity is slowly going down, and also ^{241} Am isotope, whose activity is increasing in time, contributes also to α-activity.

FCM neutron activity is defined mainly by spontaneous fission neutrons of ^{244}Cm. Annual activity drop has an insignificant tendency for fluctuations, which is ~ 2 %. It is supplemented by neutron fluxes caused by (α, n) reactions and seasonal fluctuations as a result of change in temperature and humidity.

Radioactive (fuel) dust represents the danger as a source of both internal human exposure and distribution of radioactive substances beyond contaminated areas, which results in contamination of adjacent rooms and the environment. By aerosol diameter, dust range varies from 1 to 250 µm. Per different estimates, submicron fractions of fuel dust are not higher than 4% of the activity [4.5.37]. The main type of radiation impact by dust is radioactive contamination of surfaces and air by α- and β-radionuclides, resulting from air flows that are generated inside the internal OS space.

Radioactively contaminated water inside the OS is mainly accumulated in rooms located below elevation +12.500m. During snow melting and intensive precipitation, small temporary water accumulations are also generated at higher elevations [4.5.12]. The major type of radiation impact by water is radioactive surface contamination (in case of leaks) and the air in rooms (in case of evaporation) by α- and β-radionuclides [4.5.37].

Control of radiological parameters inside and outside OS is carried out according to requirements stated in [4.3.1, 4.1.3, 4.3.9, 4.3.10, 4.3.1.1].

Subjects of radiation monitoring include [4.3.1]:

- Fissile material accumulation (functions overlapping with nuclear monitoring system);
- Facilities and rooms, where scheduled work is conducted;

- Stairs and corridors along major personnel routes in the direction of premises containing nuclear material accumulations;
- Rooms, which are related to the transport and engineering diagram of RAW management;
- Work areas in the local zone and on the industrial site.

Regulation [4.3.1] establishes reference and critical levels of parameters of radiation and engineering monitoring and environmental monitoring.

With the exception of certain work areas, presented γ-radiation dose rates [4.5.3, 4.5.8, 5.1.8, 5.1.15, 4.5.37] are of high accuracy. However, before starting the work in the areas of the NSC shell adjoining to existing structures, it is necessary to measure dose exposure rate and compare it with estimated values. In case of revealing significant differences it is required to develop supplementary measures for radiation protection and correct the acceptable time for the presence of workers in such a medium.

Radiation monitoring during work execution will be necessary to measure characteristics of air and surface contamination in work areas for more precise determination of contamination conditions.

3.4.1 AIR CONTAMINATION INSIDE OS

Radioactive materials located in Unit 4 Central Hall (room 904/2) and Turbine Hall as well as radioactive dust on surfaces in unattended rooms (rooms 504/2, 305/2, and rooms of drum-type steam separator, etc.) are the major sources of radioactive aerosols intake in the air of OS rooms.

Airflows transfer radioactive aerosols inside OS rooms; flows are generated by natural ventilation and temperature difference in rooms. Ventilation rate is defined by pressure drop inside and outside OS, generated by wind force and air temperature drop.

Higher values of volume activity of aerosols in the air are observed in rooms during intensive construction activities and high wind periods.

Table 3.4-1 [4.5.3-4.5.9.b, 4.5.37] presents maximum and minimum values of volumetric activity of the aerosols in the OS controlled rooms for 2000 – 2007.

Table 3.4-1. Values of Volumetric Activity of Aerosols in the Air of OS Room in 2000 – 2007

SUBJECT PARAMETER / YEAR	YEAR							
	2000	2001	2002	2003	2004	2005	2006	2007
Volumetric activity of α-aerosols*, Bq/m^3	$3.7\ 10^{-3}$ - 17.0	$3.7\ 10^{-4}$ $-3.2 10^{-1}$	$3.7\ 10^{-4}$ - 8.9	$0.2\ 10^{-3}$ - 13.0	$0.8\ 10^{-3}$ - 4.9	$1.2\ 10^{-4}$ - 0.84	$5.8\ 10^{-5}$ $-1.3\ 10^{-1}$	$5.5\ 10^{-5}$ - $8.0\ 10^{-2}$
Volumetric activity of β- aerosols *, Bq/m^3	0.37 - $1.3\ 10^3$	$3.7\ 10^{-2}$ - 77.7	$1.9\ 10^{-2}$ - $1.9\ 10^3$	$1.0\ 10^{-2}$ - $3.2\ 10^2$	$2.0\ 10^{-2}$ - $6.2\ 10^2$	$1.3\ 10^{-3}$ - $1.4\ 10^{-2}$	$4.0\ 10^{-5}$ - 2.9	$4.2\ 10^{-4}$ - 4.0

** - Maximum values of volume activity of aerosols were measured in unattended rooms*

During the implementation of stabilization measures for the supports of Beams Б1/Б2 in 1999, the minimum value of volumetric activity of α- and β-nuclides was $4{\cdot}10^{-3}$ Bq/m^3 and the maximum value (during welding) was $2.3{\cdot}10^3$ Bq/m^3.

In the area of MDSS nozzles (Central Hall), local values of air volumetric activity can reach $6.5{\cdot}10^3$ Bq/m^3 by ^{137}Cs and $1.0{\cdot}10^3$ Bq/m^3 by ^{90}Sr. Maximum values of volumetric activity of the bypass air during MDSS testing was 5.1 Bq/m^3 by ^{137}Cs.

During the implementation of stabilization measures for Western and Eastern Supports of the Mammoth Beam, values of volume activity of personnel breathing area constituted the following values:

- By α- nuclides - $1.5{\cdot}10^{-3}$ Bq/m^3- 6.5 Bq/m^3, including 2.5 Bq/m^3 by ^{241}Am;
- By β- nuclides - $5.5{\cdot}10^{-1}$ Bq/m^3 - $6.9{\cdot}10^2$ Bq/m^3.

When implementing other stabilization measures, such as construction works under Measures No2, No 8, No5 and No11, concentration of the radioactive aerosols in the personnel breathing area varied with the following range [4.5.37]:

- α-active aerosols - $1.0{\cdot}10^{-3}$ Bq/m^3- $3.6{\cdot}10^{-1}$ Bq/m^3;
- β- active aerosols- $2.9{\cdot}10^{-2}$ Bq/m^3 - $3.4{\cdot}10^{+1}$ Bq/m^3.

Table 3.4-2 [4.4.1] shows major radionuclide composition and activity distribution in aerosols depending on aerosol diameter (AD).

Table 3.4-2. Major Radionuclide Composition and Activity Distribution in Aerosols

RANGE OF AEROSOL DIAMETEr, μm,	CONTRIBUTION TO ACTIVITY BY RADIONUCLIDE, %						
	^{90}Sr	^{137}Cs (S)	^{137}Cs (F)	^{238}Pu	^{239,240}Pu	^{241}Pu	^{241}Am
below 0.49	9.64	9.86	9.86	0.07	0.15	3.23	0.18
from 0.49 to 0.95	3.21	3.29	3.29	0.02	0.05	1.08	0.06
from 0.95 to 1.5	3.50	3.59	3.59	0.03	0.06	1.18	0.07
from 1.5 to 3.0	3.80	3.89	3.89	0.03	0.06	1.27	0.07
from 3.0 to 7.2	3.80	3.89	3.89	0.03	0.06	1.27	0.07
above 7.2	5.26	5.38	5.38	0.04	0.08	1.76	0.10
Radionuclide content, %	29.20	29.89	29.89	0.21	0.46	9.80	0.56

The distribution of particle dispersion composing aerosols in OS rooms, is a constant function neither of a specific OS room nor the entire OS. In particular it depends on impact on the surfaces where radioactive dust has settled.

For more than 10 years no data has been accumulated, which would verify the existence of significant movement of contaminated air from OS to Unit 3 rooms. There is no record of increasing values of air volume activity either by α- or β-nuclides in Unit 3 rooms. Also, there is no indication of radioactive contamination of floors or walls in rooms caused by the radioactive air movement outside OS.

3.4.2 RADIATION CONDITIONS IN OS ROOMS

Tables 3.4-3, 3.4-4, 3.4-5 [4.5.8] present values of γ-radiation exposure rates and surface contamination density in OS rooms; including external structures of the localizing construction facility. These information will be updated upon submission of updated information by the Employer.

Table 3.4-3. Radiation Conditions in OS Rooms

№	SUBJECT PARAMETER	VALUE OF PARAMETER
1	EDR of γ- radiation (mR/hour)	0,1-7000
2	α-contamination, removable (particle/(cm^2·min))	1-2900
3	β- contamination, removable (particle/(cm^2·min))	10-120000

Table 3.4-4. Radiation Parameters in Areas Attended by Personnel

№	SUBJECT TO MONITORING	EDR, mR/h	α-Contamination, removable (part./(cm^2·min))	β-Contamination, removable (part./(cm^2·min))
1	Rooms of periodic attendance by workers (Unit 4)	0,1-2,6	0-5	10-450
2	Rooms of permanent attendance (NIAS)	0,1-1,0	0 - 1	2-3
3	Rooms of permanent attendance by workers (Unit 4)	0,1-1,2	0 - 1	10-50
4	Rooms of permanent attendance (Unit 3)	0.1-1.7	0 - 1	5-20
5	Rooms of permanent attendance (Unit 3)	0.1-0.8	0 – 2	10-100

Table 3.4-5 presents the distribution of observed OS rooms depending on their EDR value.

The contamination level of the Deaerator Rack rooms is significantly lower than the one of Unit Б rooms. The number of rooms, where γ-radiation dose rate is higher than 1.0 R/h is insignificant and they are mainly located at negative elevations, where the equipment for LRAW pumping and unattended rooms are placed, and elevations +29.000 - +35.000 where civil structures are significantly ruined.

Gamma dose rate at elevation +5.000 and +12.500 of Turbine Hall is 0.5 – 2.5 R/hour at turbines 7 and 8 and 0.2 R/hour – at external walls.

Table 3.4-5. Distribution of OS Rooms by EDR Value

EDR, R/h	NUMBER OF UNIT ROOMS				
	UNIT Б	UNIT В	NIAS	UNIT Г (TURBINE HALL)	UNIT Г (DS)
Up to 0.5	60	17	61	59	140
0.5 – 1	18				1
1 – 5	67			6	1
5 – 10	7			1	
10 – 50	17				
50 – 100	6				
100 – 500	4				
> 500	7				
Inaccessible rooms	126		4	28	7

Table 3.4-6. EDR Reference and Contamination Levels of OS Rooms

№	SUBJECT ROOMS	EDR Reference Level, R/hour	α-contamination Reference level (part./(cm^2·min))		B- contamination Reference level removable (part./(cm2·min))	
			removable	general	removable	general
1	Surfaces of rooms and equipment within periodically rooms of Unit4	2.6	10	50	500	5000
2	Surfaces of rooms and equipment within permanently attended rooms of Unit4	1.2	5	10	200	1600
3	Surfaces of rooms and equipment within Personnel Training Centre & Maintenance Shop, Administration Building (OS Industrial zone) rooms	0.5	X	X	100	400

3.4.3 RADIOLOGICAL CONDITIONS AT OS ROOF AND UPPER UNSTABLE STRUCTURES

3.4.3.1 Radiation condition analysis in Work Area (WA) during NVS Construction

The available radiation condition data in zones of NVS construction scheduled works were collected and analyzed during preparations for arrangement of surveys of Unit B rooms.

Results of previous surveys [4.5.41, 5.3.61] and data on radiation conditions for some rooms submitted by the Employer were used for radiation condition data analysis.

The generalized radiation condition data are presented in Table 3.4-7. The conclusions made on the data analysis basis are as follows:

1. Gamma-radiation dose rate:
   - The measured EDR mainly coincide or have insignificant distinctions as compared with the Employer data. At Unit B roof at Elevation + 71,200 per investigation data, the EDR in WA roof is 90 - 470 mR/h. According to data of 2008 survey performed by the Employer (see Fig. 3.4-1) the EDR measured values are a little higher, namely from 200 to 1200 mR/hour. In the latter case, the upper boundary of EDR is stipulated by availability of the spot local sources of gamma radiation on the roof of Unit B at Elevation +71,200.
   - Need of more detailed study of gamma-radiation EDR is identified only for room 7001 and roofing at elev. + 71,200.
   - Analysis of gamma-radiation angular distribution has not revealed the need of shielding of gamma-radiation sources forming radiation environment in WA in room 7001 and on the roof at Elevation + 71,200.
   - During design when performing analysis of the shielding efficiency against local gamma radiation sources during works on the roof of Unit "B", it is recommended to apply actual data measured during pre-design survey stage: for thickness of shield made of lead: 5, 10 and 20 mm, and gamma-quanta energy of 320, 450 and 600 keV accordingly. The analysis of shielding efficiency for the local gamma-radiation sources during the works on the roof of Unit B shall be performed based on ALARA principle.
2. Surface contamination:
   - The results of the data analysis demonstrate that the maximum part of removable beta activity of surface contamination equals 7% of general beta-contamination.
   - It is necessary to note that the data received from the sample analysis can vary with an extent of 10 depending on the sampling location. Samples can also include large particles that conventionally are not classified as dust but attributed to category of "non-fixed contamination". Therefore it is necessary to take into account the fact that accuracy of determination of the removable surface contamination part is low due to limited number of the analyzed samples and occurrence of highly active individual fragments essentially influencing the average results.
3. Air contamination is controlled only in attended and periodically attended rooms and does not exceed the reference levels (RL) determined for relevant sub-zone. Air contamination is not controlled in unattended rooms. In accordance with the results of the surveys performed earlier, values of aerosol concentration in the air of individual unattended rooms vary within the range from 0.5 to 50 Bq/m^3 for β- active and from 0,0003 to 0,1 Bq/m^3 for α- active nuclides.

Radiation situation in rooms where the works on NVS construction will be performed is characterized below:

- **Room 7001.** EDR varies in the range of 30-240 mR/hr. The highest values are observed immediately close to the vent header. Density of the total surface β-contamination in the most contaminated places may reach 105 part/(cm^2·min). Non-fixed (removable) surface β-contamination reaches 500 part/(cm^2·min).
- **Room 4004/1.** At the reconstructed in 2007 air-duct "Bypass" the EDR of gamma-radiation varies between 33 and 35 mR/hour at Elevation +49,900, between 17 and 23 mR/hour at Elevation +55,000 and between 17 and 28 mR/hour at Elevation +62,800. In the rest of Room 4004/1, the gamma EDR varies between 6 and 35 mR/hour. The density of the total surface beta-contamination in this room reaches 80000 part/(cm^2·min). Non-fixed

(removable) surface beta-contamination reaches 300 part/(cm^2·min). During reconstruction in 2007 of the "Bypass" air-duct partial, the room was decontaminated what resulted in decreasing of the level of removable surface contamination.

- **Room 4005/2**. The gamma-radiation EDR varies between 15 and 20 mR/hr. Surface contamination data (total and removable) are unavailable.
- **Rooms 4004/2 & 4005/1**. The gamma-radiation EDR in WA varies in the range from 5 to 20 mR/hr. There are some discrepancies in EDR measured in different years (2003 and 2007). Apparently, this is caused by distinction in co-ordinates of measuring points. Density of the total surface β-contamination in these rooms reaches 15000 part/(cm^2·min). Non-fixed (removable) surface β-contamination reaches 500 part/(cm^2·min).
- **Room 5002.** The gamma-radiation EDR varies in the range of 0,4 - 3,0 mR/hr. There are some discrepancies in EDR, received in different years (2003 and 2007). Apparently, this is caused by distinction in co-ordinates of measuring points. Density of the total surface β-contaminations reaches 15000 part/(cm^2·min). Non-fixed (removable) surface β-contamination reaches 20 part/(cm^2·min).
- **Rooms 5003/3, 5003/4, 5003/5, 5003/6, 5003/9.** The gamma-radiation EDR in WA varies in the range of 0,2 -1,0 mR/hr. Density of the total surface β-contamination in these rooms is relatively low and reaches 300 part/(cm^2·min). Non-fixed (removable) surface β-contamination reaches 10 part/(cm^2·min).
- **Room 5003/10**. The gamma-radiation EDR in WA varies in the range from 0,4 to 1,0 mR/hr. Density of the total surface β-contamination reaches 600 part/(cm^2·min). Non-fixed (removable) surface β-contamination reaches 10 part/(cm^2·min).
- **Room 6002/3**. Gamma-radiation EDR varies in the range 10 to 35 mR/hr. Density of the total surface β-contamination reaches 4000 part/(cm^2·min). Non-fixed (removable) surface β-contamination reaches 100 part/(cm^2·min).
- **Rooms 6002/4, 6002/6, 6002/9, 6002/10**. Gamma-radiation EDR varies within the range 0,1 - 5mR/hr. There are some discrepancies in EDR, received in different years (2003 and 2007). Apparently, this is caused by distinction in co-ordinates of measuring points. Density of total surface β-contamination reaches 400 part/(cm^2·min). Non-fixed (removable) surface β-contamination reaches 10 part/(cm^2·min).
- **Unit B roof at Elevation +71.200**. Gamma-radiation EDR at elevation +71,200 varies from 200 to 1200 mR/hr. Radiation environment is determined by radiation from main FCM accumulations, and also possible occurrence of intensive shielded gamma-radiation sources. Radiation environment on the OS roof is presented in Table 3.4-7 and Fig. 3.4-1 and 3.4-1a.
- **Unit B roof at Elevation +55.500**. Gamma-radiation EDR at Elevation +55,500 varies in the range from 40 to 200 mR/hr. In the design it is recommended to use average EDR value for works on the roof at Elevation +55,500 being 120 mR/hr.
- ˜**NVS vertical erection area to +125,000 between Rows Д1-Ж.** There are no data on radiation environment in these areas. Investigation plan did not provide for radiation condition studying in these zones since for this purpose additional complex of organizational and engineering measures (start-off of balloon or meteorological balloon from the OS roof) would be required. To develop design solutions it is proposed to use available radiation condition data on 1 - 3 sites of VS-2, considering that EDR in these zones is mainly determined by radiation from main FCM accumulations inside the Shelter and to a lesser degree by contamination of the sites.

˜5. Radiation condition data analysis demonstrates that most radiation-hazardous works during NVS construction are the following:

- Works in rooms and on roofs where EDR may exceed 100 mR/hr;
- Works affecting the contaminated surfaces in rooms with increased density of surface contamination. These works may result in significant air contamination under secondary dust release and, as a consequence, increased internal exposure dose of the personnel.

6. As a whole, radiation environment parameters in periodically attended and permanently attended rooms do not exceed the reference levels determined by regulating document [4.1.3].

7. Radiation environment in rooms of 1, 2 and 3 zones of Unit B (excluding rooms 4004/1, 7001) is stipulated by availability of removable and non-removable surface contamination (local sources are unavailable in them and radiation from main accumulations of fuel-containing materials in OS is strongly attenuated by concrete walls).

8. Most radiation hazardous rooms are rooms of Zone 3 and Unit B roof. The main component of radioactive contamination in these rooms is ^{137}Cs (83-85 % and 94 % of total activity). Other radionuclides, determining radioactive contamination of these WA, are - ^{90}Sr (up to 13 %) and TUE (up to 2 %).

9. Rooms of 2nd and 3rd zones are characterized by low levels of surface contamination density and gamma-radiation EDR. Room 5002 with high values of density of surface contamination is excluded. Contamination from radioactive dust suspended at operation in rooms of 1st zone during performance of works may require utilization of relevant PPE, as well as additional decontamination of rooms, equipment, etc both during and after completion of works.

10. The available radiation condition data are insufficient for development of design solutions, in particular, measures to provide radiation safety (RS). This conclusion is based on the following:

- There are no data on angular distributions of the main sources and attenuation rate of gamma radiation;
- There are no data on radioactive air contamination in rooms of NVS works;
- Available gamma-radiation EDR data and density of surface contamination are not connected to construction co-ordinates of rooms;
- There are no gamma-radiation EDR distribution cartograms in rooms;
- For some rooms there are no data about surface contamination density.

Consequently, information on radiation conditions in WA planned for NVS construction is not complete. Respectively, in order to perform adequate assessment of planned dose uptakes of personnel, and development of design solutions and radiation protection measures, arrangement of additional radiation environment surveys is necessary.

Table 3.4-7. Radiation situation parameters in rooms where performance of works on NVS construction is scheduled

Elevation	Name of the surveyed room	Number of the rooms in the Plan	Surface contamination							EDR, mR/h				Zoning of the surveyed rooms in 2007
			Radionuclide composition; %			General beta-contamination, part/(cm².min)		Removed beta-contamination, part/(cm².min)		2003		2007		
			^{137}Cs	^{60}Co	^{90}Sr	min	max	min	max	Data range	Average	Data range	Average	
+43.00	Radiation Safety Department Room	2015/1	94	6		60	300	10	15	0.1 – 0.7	0.5	0.1 – 0.6	0.5	3
	Auxiliary Room	2017/1	94	6		100	300	10	15	0.4 – 0.5	0.5	0.4 – 0.5	0.5	Special
+49.900 – 62.800	Exhaust Ventilation Bypass	4004/1, Rows Д1-И (Elev. +49,90)	No measurement performed			5000	80000	50	300			6 – 12	9	1
		4004/1, Rows Л-M, Axes 39-40 (Elev. +55,00)										17 – 23	20	
		4004/1, Rows Л-M, Axes 39-40 (Elev. +62,80)										17 – 28	23	
+49.90	Vent Header	4004/2 Rows Д1-И	85	3	11	2800	15000	500	500	2.5 – 20.0	11.3	5.0 – 15	10.0	1
	Filtering Station	4005/1 Rows Д1-И	83	5	12	2200	15000	155	500	1.0 – 16.7	8.0	15 – 20	20	1
		4005/2 Rows Д1-И	No CERS performed									15 – 20	20	1
+55.000	Shaft for freight delivery from transportation corridor of Unit 3 to upper elevations of Unit B	5001, Row M-P	83	4	13	500	2000	10	20	5.0	5.0	4.0-5.0	4.5	Special sub-zone
	Room of Electric Motors	5002 Rows Д1-И	83	4	13	200	1500	10	20	0.2-1.3	0.5	0.4-2.5	2.0	Special sub-zone

Elevation	Name of the surveyed room	Number of the rooms in the Plan	Surface contamination							EDR, mR/h				Zoning of the surveyed rooms in 2007
			Radionuclide composition; %			General beta-contamination, part/(cm².min)		Removed beta-contamination, part/(cm².min)		2003		2007		
			^{137}Cs	^{60}Co	^{90}Sr	min	max	min	max	Data range	Average	Data range	Average	
+55.00	Fan Box	5003/3	83	4	13	100	250	5	10	0.2-0.6	0.5	0.2-0.6	0.5	Special sub-zone
		5003/4	83	4	13	150	300	5	10	0.4-0.5	0.5	0.4-0.5	0.5	Special sub-zone
		5003/5	83	4	13	100	250	5	10	0.6-1.5	1.0	0.6-1.5	1.0	Special sub-zone
		5003/6	83	4	13	150	250	5	10	0.4-1.1	0.7	0.4-1.0	1.0	Special sub-zone
		5003/9	83	4	13	50	100	5	10	0.1-0.3	0.2	0.2-0.3	0.3	Special sub-zone
		5003/10	83	4	13	100	600	10	10	0.4-1.2	0.8	0.4-1.0	0.8	Special sub-zone
+55.60	Vent Header Ceiling Slab	b/a Д1-Ж	No CERS performed (relative to OS)									8-16	12	1
+61.00	Fan Box	6002/3	83	4	13	1500	4000	50	100	10.0-35.0	20.0	10.0-35.0	20.0	1
		6002/4	83	4	13	300	400	5	10	9.0	9.0	0.2-5.0	4.0	1
		6002/6	83	4	13	150	200	5	10	2.0-5.0	3.5	0.1-0.2	0.2	1
		6002/9	83	4	13	200	300	5	10	1.5-5.0	2.5	0.2-0.5	0.4	1
		6002/10	83	4	13	200	300	5	10	1.0-3.5	2.0	0.2-0.5	0.4	1
+67.00	Filtering Plant	7001 Rows Д1-И	83	4	13	2200	1.1·105	155	500	1-120\238	36.8	30-200	50	1
+71.200	Roof of Unit B	Axes 36-40, Rows Г-И	No measurement performed			Density of beta-particles flow in high fields of EDR is not measured due to high error		50	4500			200 – 1200	500	1

Elevation	Name of the surveyed room	Number of the rooms in the Plan	Surface contamination							EDR, mR/h				Zoning of the surveyed rooms in 2007
			Radionuclide composition; %			General beta-contamination, part/(cm².min)		Removed beta-contamination, part/(cm².min)		2003		2007		
			^{137}Cs	^{60}Co	^{90}Sr	min	max	min	max	Data range	Average	Data range	Average	
+85.00	VS-2	Site No.1	No measurement performed			Density of beta-particles flow in high fields of EDR is not measured due to high error		No measurement performed		250 – 400	400	-	-	1
+99.00	VS-2	Site No.2	No measurement performed			Density of beta-particles flow in high fields of EDR is not measured due to high error		No measurement performed		350 – 850 \ 1500	600	-	-	1
+111.00	VS-2	Site No.3	No measurement performed			Density of beta-particles flow in high fields of EDR is not measured due to high error		No measurement performed		250 – 600	400	-	-	1
+71.50-111.00	Access Route	To site No.3 VS-2	No measurement performed			Density of beta-particles flow in high fields of EDR is not measured due to high error		No measurement performed		250 – 300	300	-	-	1

Картограмма МЭД на кровле между 3 и 4 блоками
на отм. +22,36 - +74,5м

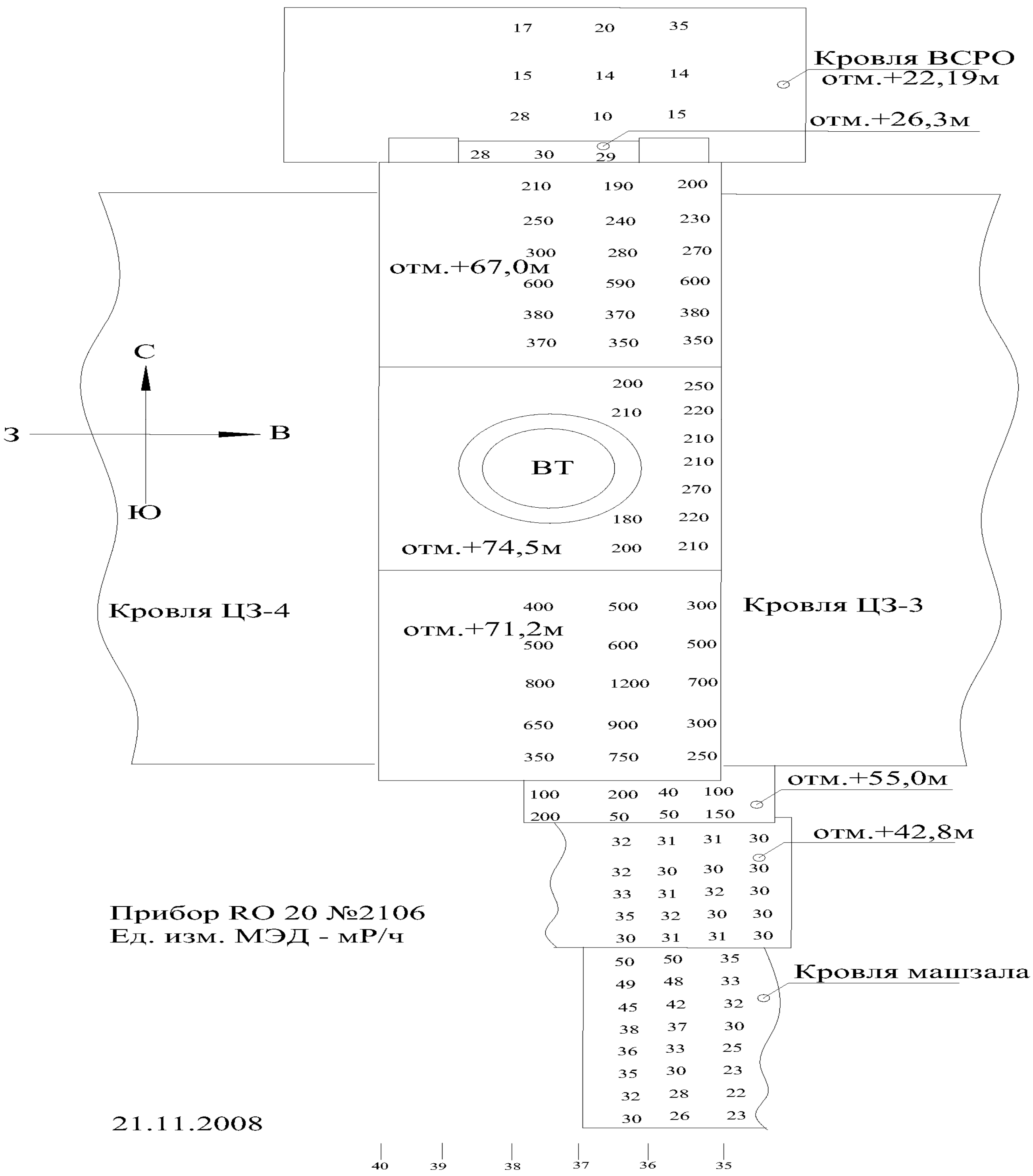


Figure 3.4-1 - EDR distribution cartogram (R/hr) on the roofs of Unit B. turbine hall

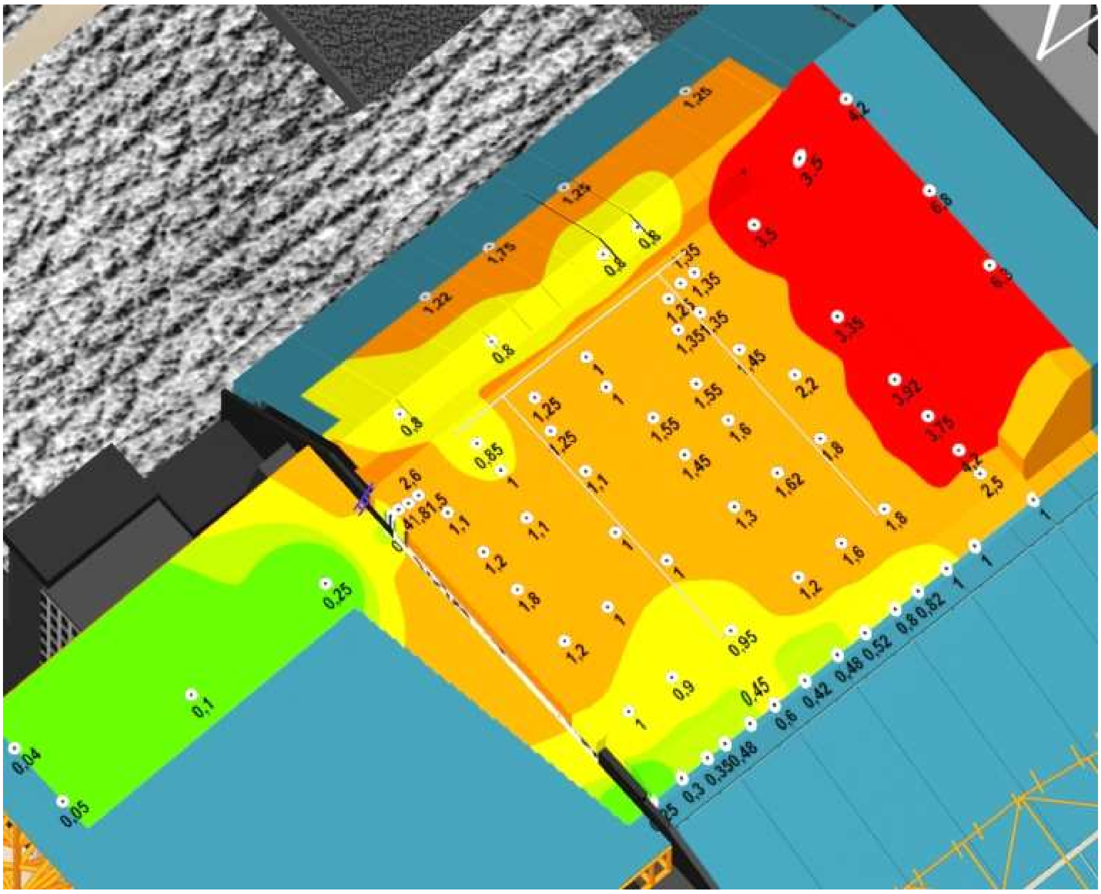


Figure 3.4-1a. EDR distribution cartogram (R/h) on the light roofing

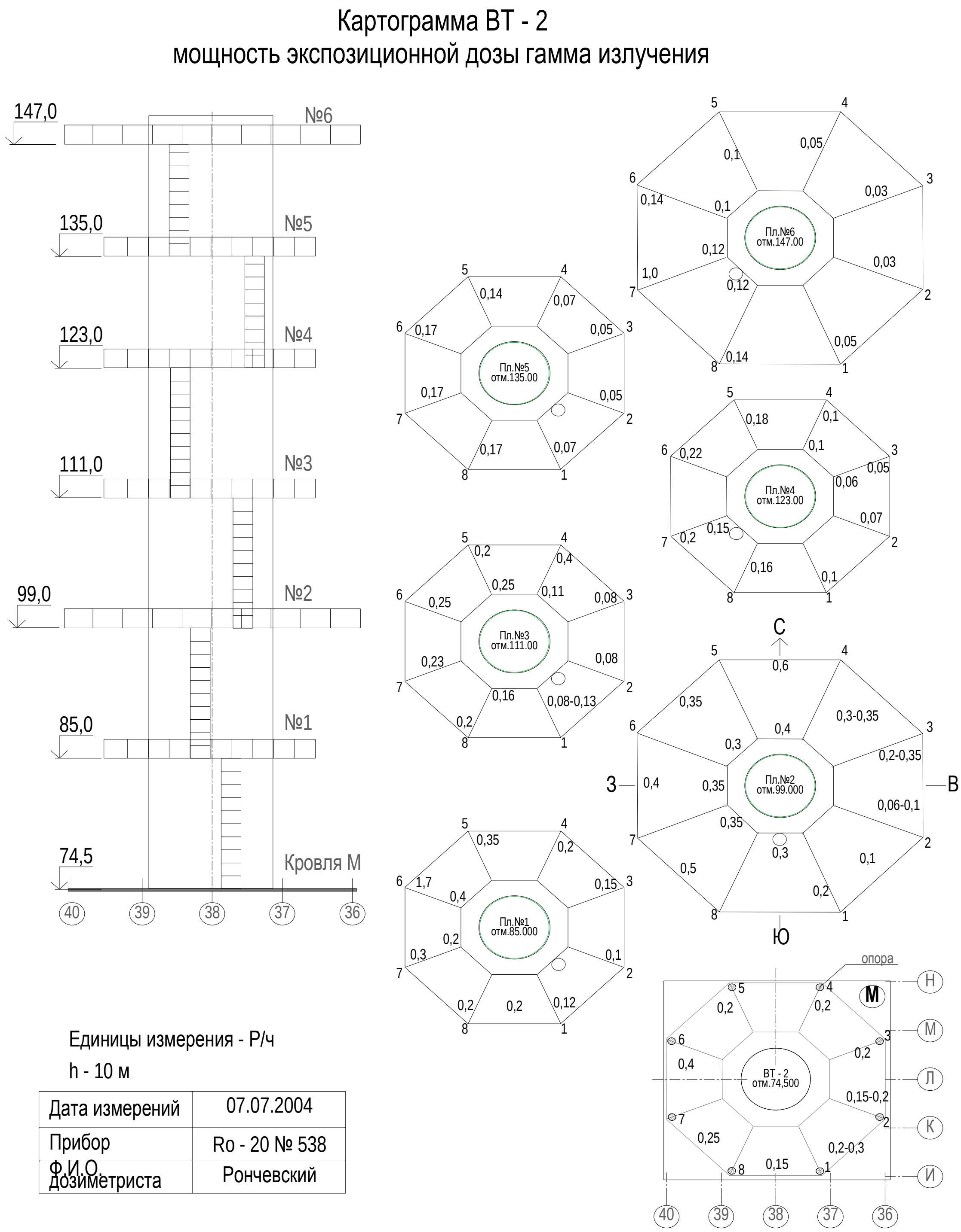


Figure 3.4-2. Radiation environment at floor 1 – 6 of VS-2

3.4.3.2 Radiation environment in rooms at elevation +67,00

Surveys at elevation +67,000 were performed in room 7001.

3.4.3.2.1 Gamma radiation exposure dose rate

Gamma radiation EDR cartograms are presented in Figure 3.4-3. Gamma-radiation EDR measurement results in room 7001 (elev. +67,000) on heights of 1,0, 1,5 and 3,0 m vary in the range of indices specified by the Employer. EDR distribution cartograms on heights of 1,0 and 3,0 m point out the heterogeneity of contamination. Areas of higher local contamination were found out in the room. Mainly, in room 7001 (elev. + 67,000), the tendency of gamma-radiation EDR reduction with increase of measurement point height from the floor surface is observed.

3.4.3.2.2 Surface contamination

Coordinates of points and surface contamination density data are provided in table 3.4-8 and figures 3.4-4 and 3.4-5.

Table 3.4-8. Surface contamination by beta active nuclides at elevation +67,00 in room 7001

Room Name	Measurement Point #	Radionuclide Composition		Total beta-Contamination, Part/(cm^2·min)	Removable beta-Contamination, Part/(cm^2·min)
		^{137}Cs	$^{90}Sr+^{90}Y$		
Filtering Plant Rows д1-и, Ceiling	5A	78	22	72000	120
Point 1; 0.2m from Floor	1A	78	22	360000	110
Point 1; 1.5m from Floor	1	81	19	73000	94
Point 2; 0.2m from Floor	2A	67	33	140000	117
Point 2; 1.5m from Floor	2	57	43	74000	270
Point 3; 0.2m from Floor	3A	41	59	200000	255
Point 3; 1.5m from Floor	3	85	15	115000	260
Column 1; 0.2m from Floor	4A	37	63	100000	310
Column 1; 1.5m from Floor	4	41	59	45000	480
Column 2; 0.2m from Floor	5A	65	35	55000	280
Column 2; 1.5m from Floor	5	67	33	28000	340

Volumetric activity of radionuclides in the air. Measurement results of volumetric activity of the main dose-generating radionuclides in the air of room 7001 are presented in table 3.4-9.

Table 3.4-9. Volumetric activity of main dose-generating radionuclides in the air of room 7001

Sampling Date	Radionuclide Volumetric Activity, Bq/m^3						
	^{238}Pu	$^{239+240}$Pu	^{241}Pu	^{241}Am	^{154}Eu	^{137}Cs	^{90}Sr+^{90}Y
	Relative Measuring Error (P=0.95)						
	±20 %	± 20 %	± 20 %	± 20 %	-	± 17%	± 30 %
05.01.08	0.13	0.26	6.8	0.42	< MDA	32	30

Note **-** ***activity of ^{241}Pu is design activity. The index was received based on the activity measurement result of ^{241}Am considering the nuclide consumption in exposed nuclear fuel («average fuel»).

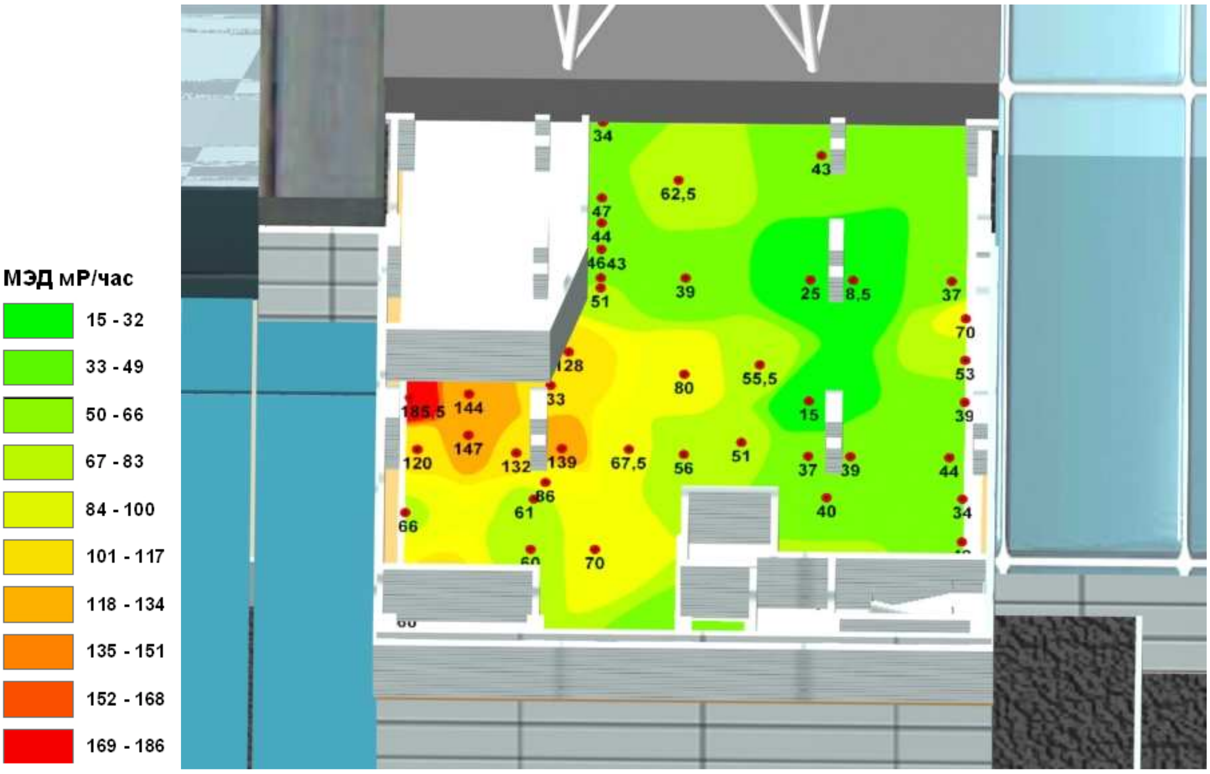


Figure 3.4-3. Gamma-radiation EDR distribution cartogram at the height 1 m in room 7001 of Unit "Б" at elevation +67,000, mR/hr

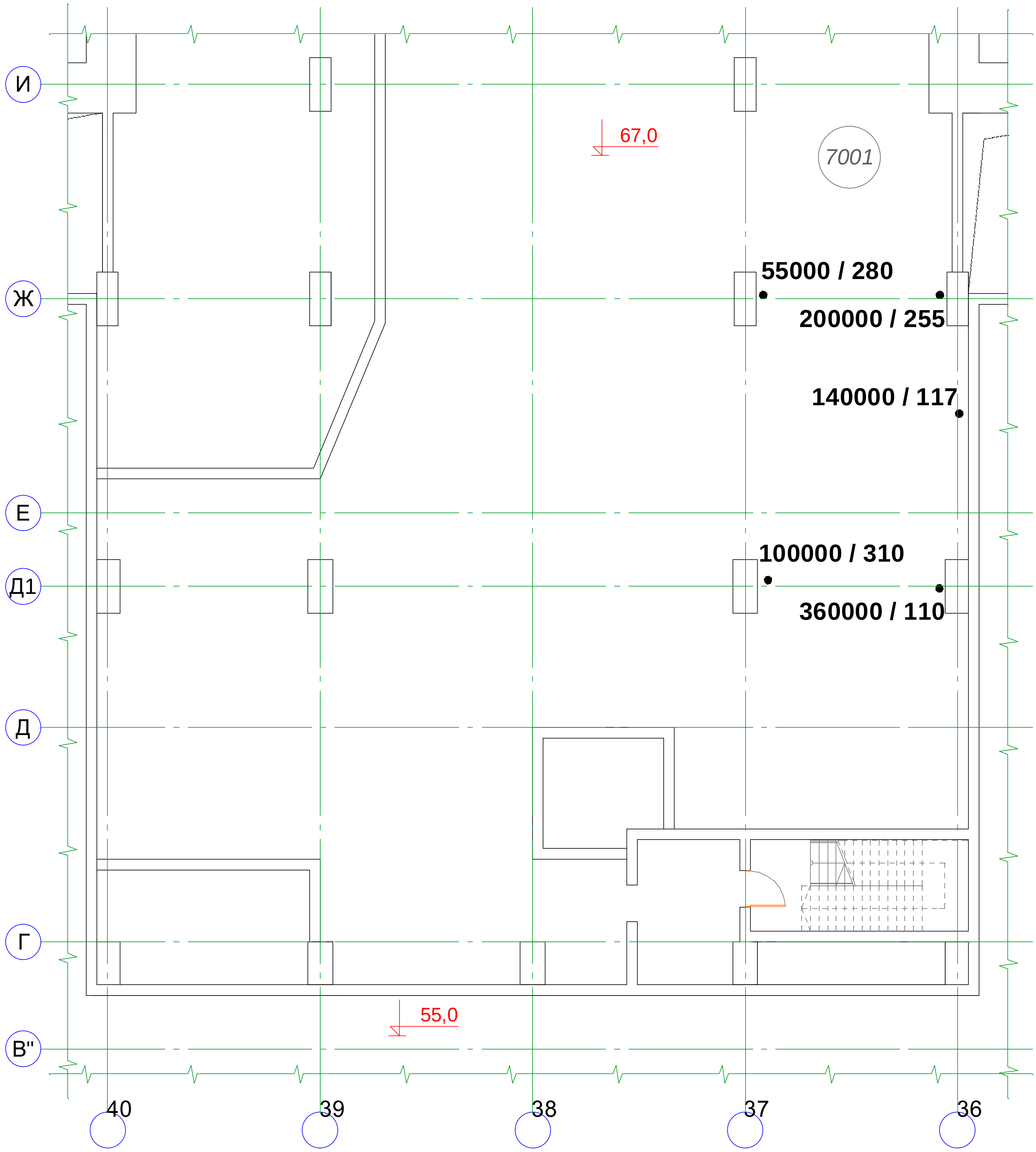


Figure 3.4-4. Values of density of beta particles (total/removable surface contamination) in room 7001 (beta-part./(cm^2·min)). Measurements of total surface contamination and smears' taking was performed at height of 0.2m

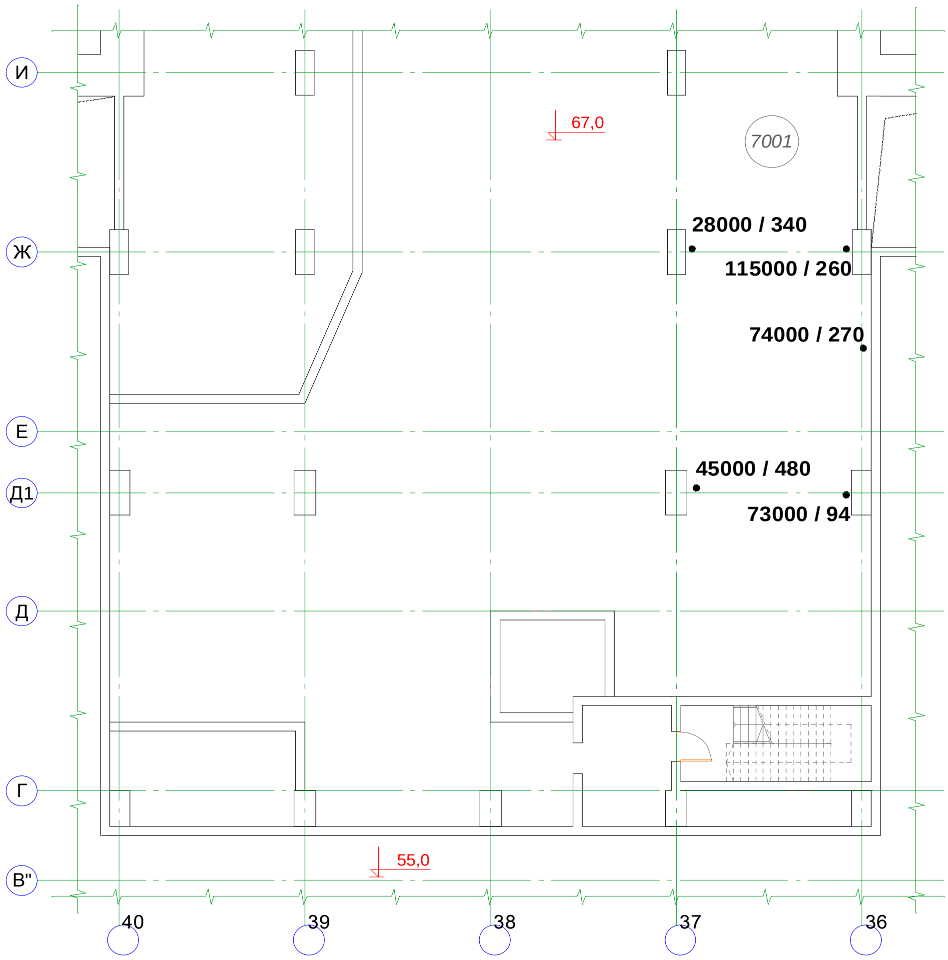


Figure 3.4-5. Values of density of beta particles (total/removable surface contamination) in room 7001 (beta-part./(cm^2·min)). Measurements of total surface contamination and smears' taking was performed at height of 1.5 m

3.4.3.2.3 Gamma-radiation intensity angular distribution

Graphical representation of measurement results is provided in figures 3.4-6 and 3.4-7. Analysis of measurement results of intensity of spot gamma-radiation sources in room 7001 (figure 3.4-6) demonstrates:

- Intensive gamma-radiation sources that can significantly influence radiation environment in WA and require for development of shielding measures are unavailable;
- All directions in a horizontal plane at the height of 1 m are more or less equivalent to intensity of sources (37 - 53 % intensity of maximum). Western direction can be considered as an exception where the double intensity is observed in distinction with the other directions (100 % intensity of the maximum);
- Intensity of the sources located in direction to the top is much lower (18 % intensity from the maximum) than in other directions.

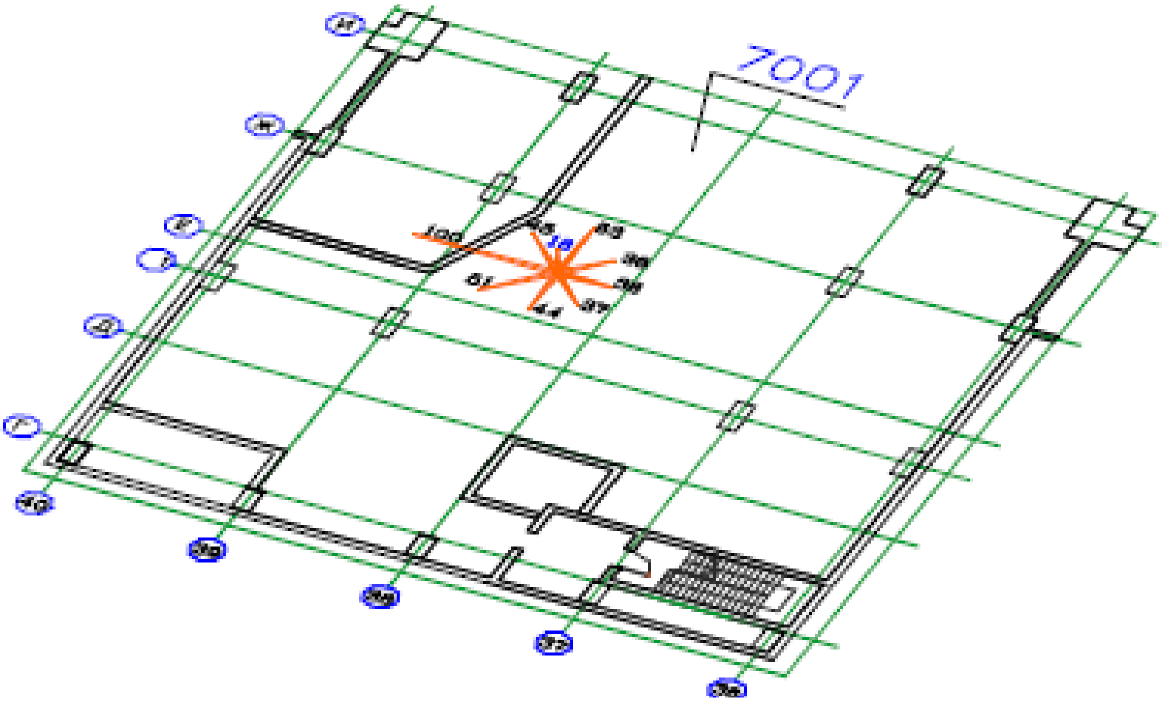


Figure 3.4-6. Measurement results of gamma-radiation intensity angular distribution in room 7001

Measurement results performed by SHD-1 unit (Figure 3.4-7) also confirm results of gamma-radiation angular distribution received by DC unit. Analysis of the measurement results demonstrates that there are no sharply defined intensive gamma-radiation spot sources in room 7001. According to the cartogram, gamma-radiation penetrates from lower hemisphere and obviously has been caused by irradiation from the FCM accumulations located in the bulks of Central Hall of Unit 4. Due to significant weakening of this radiation between the concrete walls the factor of gamma-radiation attenuation rate was not determined.

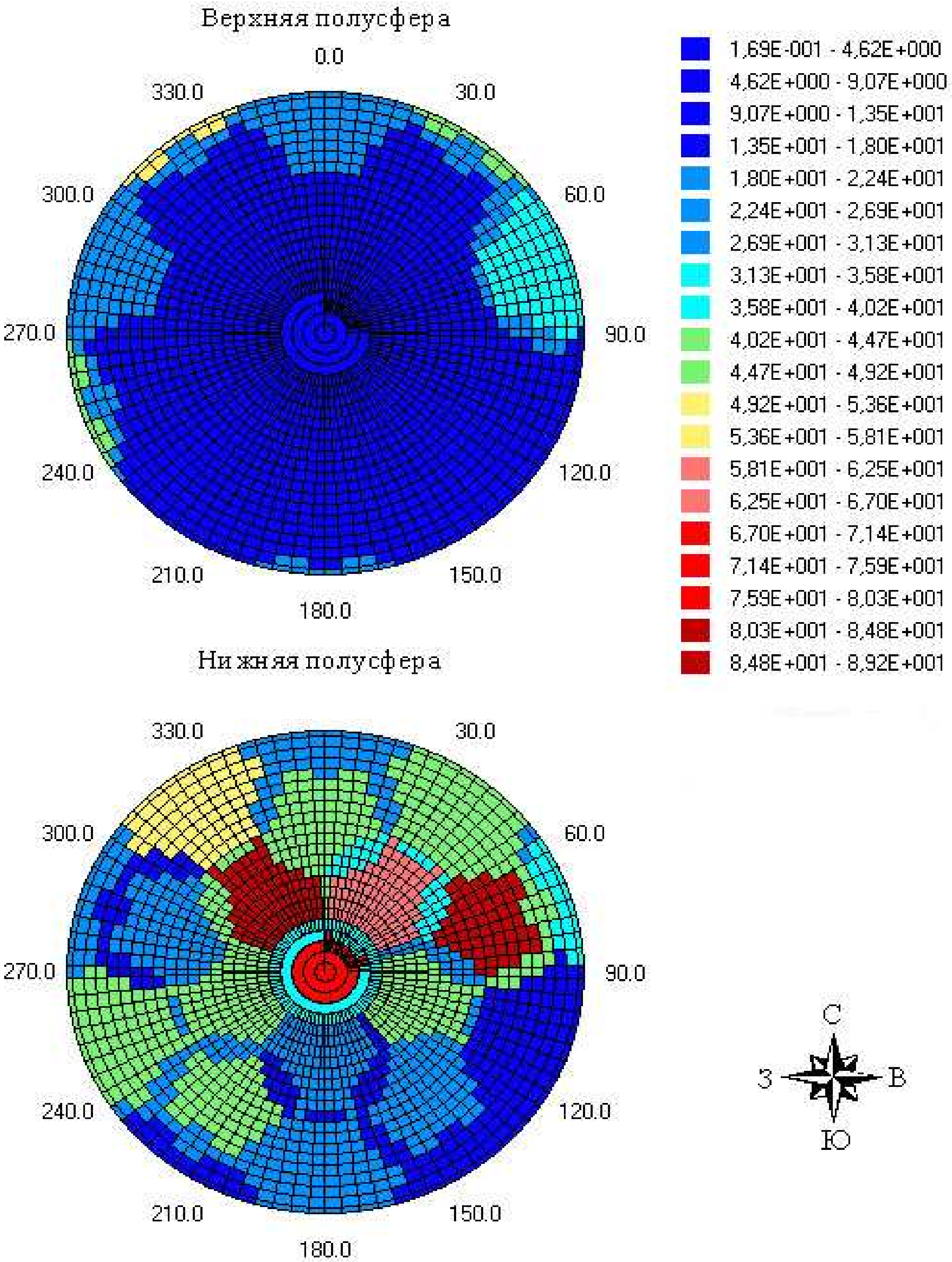


Figure 3.4-7. Cartogram of gamma-radiation intensity angular distribution in room 7001, point Ш50, mR/(h.sr)

3.4.3.2.4 Erection zone on the roof of Unit "B" at elevation +71,00

Activity on the roof of Unit "B" of CHNPP second construction stage is the most radiation-hazardous. First and foremost, radiation conditions are characterized by high values of gamma

radiation created by powerful sources of gamma -radiation (FCM accumulations), shielded sources on the roof. Places and types of performed radiation environment parameter measurements in WA on the roof of Unit "B" (Elev. +71,200) are shown in Figure 3.4-8.

3.4.3.2.5 Exposure dose rate.

Gamma-radiation EDR measurement results 0.1 m and 1.0 m height from Unit "B" roof are presented in Figure 3.4-8. The measurements were performed not over the entire rood of Unit B at Elevation +71,200, but only within the zone of works for NVS construction. Gamma-radiation EDR distribution in this zone is characterized by considerable gradient from East to West (exceeding in 1,5 - 2,0 times) and from South to North (exceeding in 3 - 5 times). Gamma-radiation EDR maximum values (500 mR/h on 1 m, 750 mR/h on 0.1) are measured in the places located in WA north-west part. Also, in accordance with gamma-radiation EDR measurement results, distribution of gamma-field intensity in WA varies in a relatively smooth way. During survey, no distinct local "spots" were detected (Figure 3.4-8).

In 2007 the Employer performed measurements of EDR fields on the roof of Unit B at Elevation +71,200, the results of which are presented as cartogram in Fig. 3.4.1. In comparison with the results of the above survey along axes 36-37 of Rows Д-Е a local spot was recorded with EDR of up to 1200 mR/hr. This distinction is stipulated by the fact that in cartogram presented in Figure 3.4-8 the measurements were performed only in the assumed places of NVS construction, and cartogram of Fig. 3.4.1. was created based on more dense network of measurements facilitated the revelation of this local increase of EDR values.

3.4.3.2.6 Determination of angular gamma-radiation intensity distribution.

Availability of local radiation sources predetermines the need of survey of angular gamma-radiation intensity distribution. Analysis of the performed angular distribution measurements demonstrates that the greatest radiation exposure at the height 1,0 m over roof is expected from below. Less impact can be observed in the sector limited by northwest and southwest directions (Figure. 3.4-9).

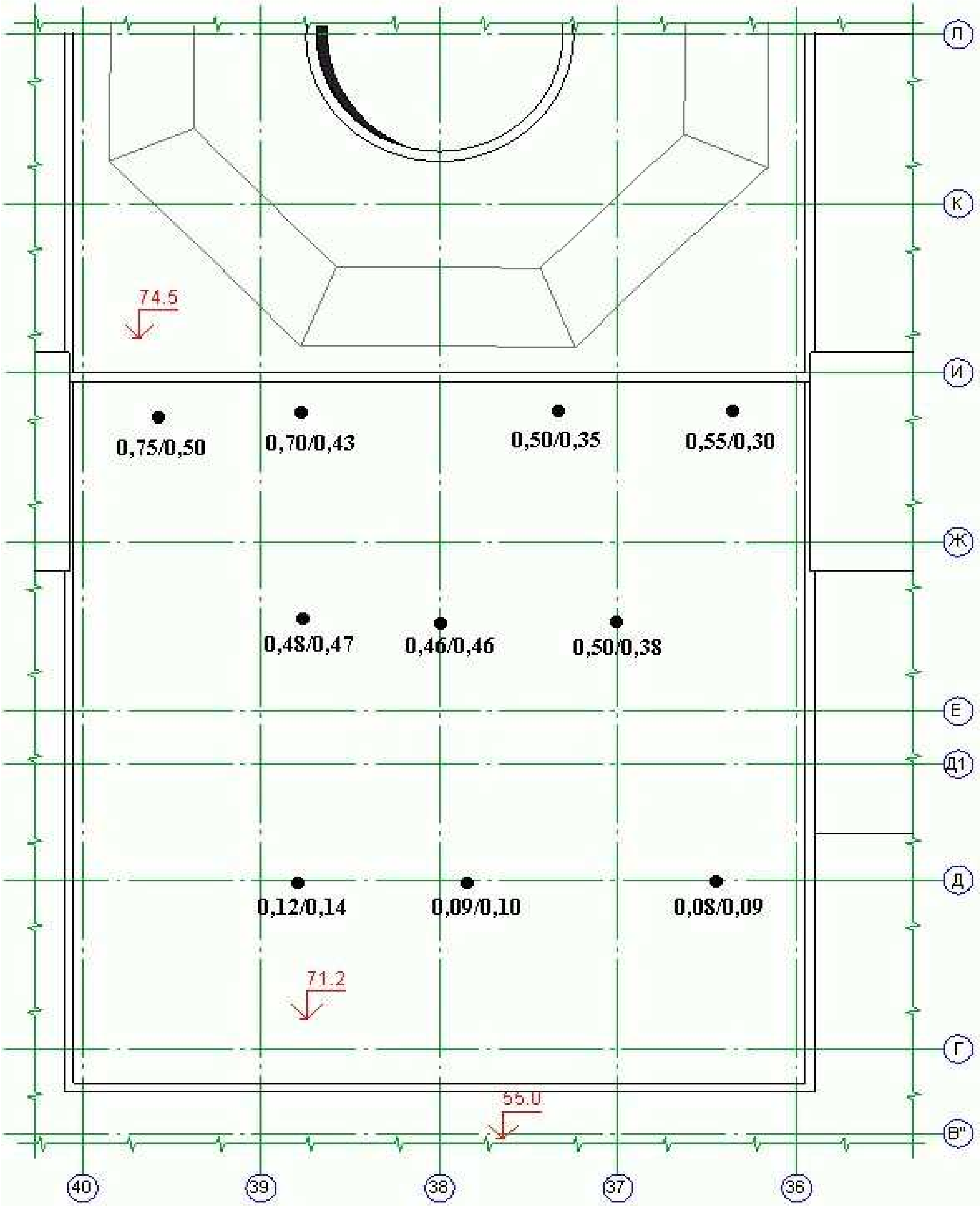


Figure 3.4-8. Gamma-radiation EDR measurement results on the roof of ChNPP unit "B", second commissioning stage at the height of 0,1 /1 m respectively, R/hr

Note: the length of the ray and its orientation characterize the intensity and direction of gamma-radiation. The ray beams under the roof surface are not shown.

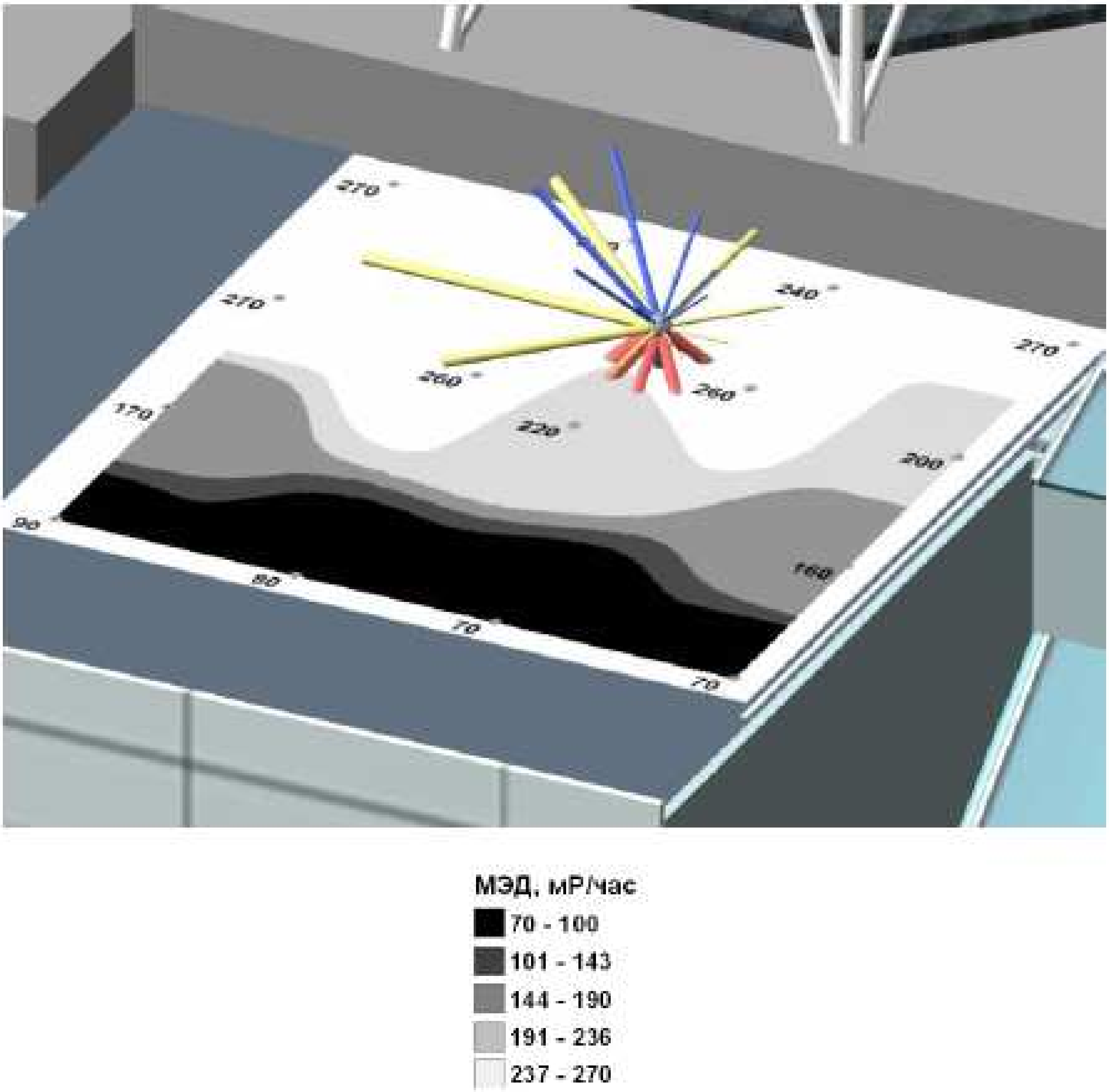


Figure 3.4-9. Gamma-radiation EDR Distribution cartogram (1 m high from the surface) and gamma-radiation intensity angular distribution on the roof of Unit "B" of ChNPP second commissioning stage between Axes 36-39 Rows «Д»-«И», mR/hr

Dependences of gamma-radiation attenuation rate on thickness of lead filter in typical measurement point are given in Figure 3.4-10. Value of gamma radiation effective energy and its dependence on thickness of probable shielding for use in given WA was estimated using the data received.

Characteristic dependence of gamma-quanta active energy change shown in "toughening" of gamma-radiation spectrum after passing through lead filter is shown in Figure 3.4-11. Consequently, one can conclude that spectral characteristics of gamma radiation field in this zone are typical for external surfaces of the facilities close to the Shelter.

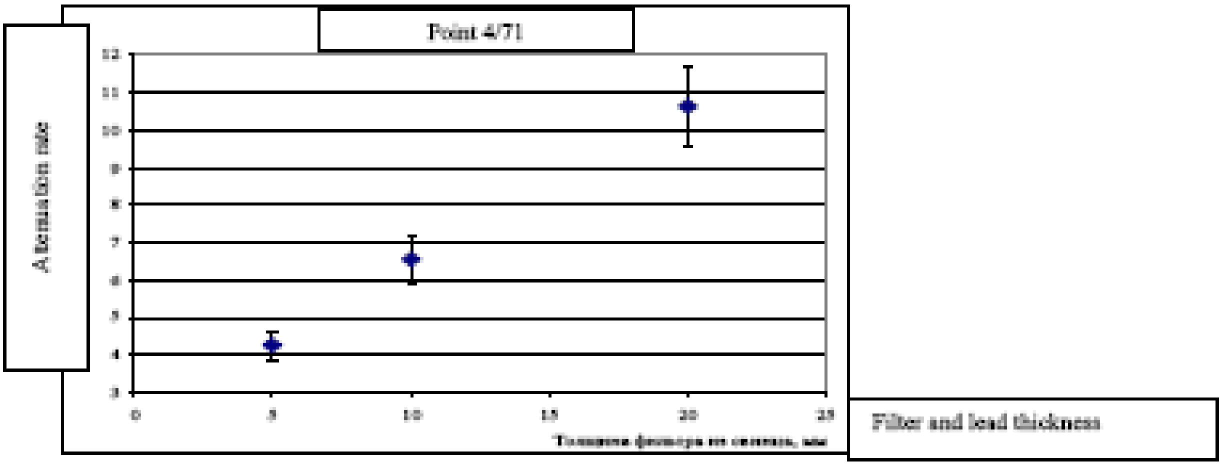


Figure 3.4-10. Dependence of gamma-radiation attenuation rate from thickness of filter (mm) made of lead in point 4/71 (elev. +71.000), north-westward direction

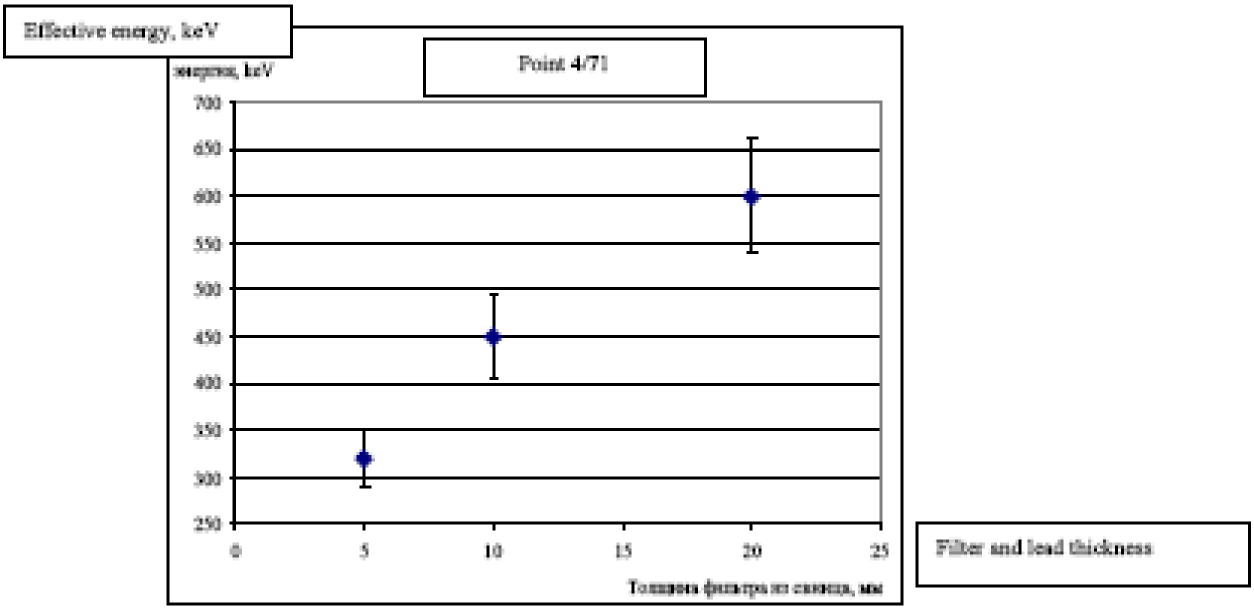


Figure 3.4-11. Dependence of gamma quanta active energy (keV) from thickness of filter (mm) made of lead in point 4/71 (elev.+71.000), North-Westward direction

3.4.4 RADIOLOGICAL CONDITIONS AT BUTTRESS WALL STRUCTURES

During the stabilization measures, in order to facilitate the stabilization of western structures of walls of the Central Hall of Unit 4 and western buttress wall, and stabilization of B1/B2 Beams, metal strengthening structures were installed. In the result of implemented measures the parameters of radiation situation have been changed in the places of adjoining of elements of metal strengthening structures with the structures of western buttress wall.

The parameters of radiation situation in the elements of metal structures and western buttress wall are presented in Table 3.4-10.

Table 3.4-10. Parameters of radiation situation in the elements of metal structures and western buttress wall

#	Metal Strengthening structures and western buttress wall sites			EDR, mR/hr	Removable surface beta contamination, part/(cm^{2}min)
1	Foundation ФМ-1			14-24	100
2	Foundation ФМ-2			30-100	100
3	Elements of Metal Strengthening structures and western buttress wall Axis 54				
	Elevation +26,000	Row П		15-30	MSS Elements -100, Outer surface of buttress wall: 400-7000
			Axis 56	10-30	
		Row Ж	Axis 54	70-130	
			Axis 56	60-80	
	Elevation +29,600	Row П	Axis 56	15-45	
		Row Ж	Axis 56	60-80	
	Elevation +41,600	Row П	Axis 54	65-80	
			Axis 56	35-50	
		Row Ж	Axis 54	140-270	
			Axis 56	130-260	
	Elevation +45,200	Row П	Axis 56	43-60	
		Row Ж	Axis 56	75-165	
	Elevation +50,500	Row П	Axis 56	25-60	
		Row Ж	Axis 56	35-240	
	Elevation +58,500	Row П	Axis 56	36-58	
		Row Ж	Axis 56	72-195	
	Elevation +61,300	Row П	Axis 50	150-1000	MSS Elements -100, Outer surface of buttress wall: 400-7000
			Axis 51`	100-500	
			Axis 56	30-50	
		Row Ж	Axis 50	150-1000	
			Axis 51`	100-700	
			Axis 56	80-130	
4	Coating from buttress wall to wall along axis 50 of Unit Б.				
		Row Е-П	Axis 51`	500-800	400-7000
		Row Ж-П	Axis 52	130-500	
5	Shielded trailers for load transfer from Beams Б1 and Б2 Axis 50				
		Row П		75-500	250-550000
		Row Ж	Axis 50	80-500	

3.4.5 RADIATION CONDITIONS IN THE LOCATIONS OF WESTERN AND EASTERN FENCING STRUCTURES OF NSC SHELL AND ELEMENTS OF TURBINE HALL, UNIT B AND NIAS ROOF ABUTMENT

Table 3.3-1 presents the coordinates of abutment locations of elements of eastern and western fencing structures to the elements of Turbine Hall, Unit B and NIAS roof.

In order to calculate the dose loads on the personnel during creation of western and eastern fencing structures of NSC it is necessary to know the parameters of radiation situation in the working places area.

Per Table 3.3-1 the western fencing structure of NCS will abut to the structures of Turbine Hall, Unit B and NIAS roof along Axis 39. Accordingly, the assumed working places for installation of western fencing structure of NCS shall be located on the roof of Turbine Hall, Unit B and NIAS roof along Axes 36-39. The Employer undertook the measurements of the existing EDR fields in the mentioned locations. The results of these measurements are presented in Table 3.4-11.

Table 3.4-11. Parameters of radiation situation in the zones of work implementation for installation of NSC western fencing structure

#	Installation Area	EDR, mR/hr	Removable beta-contamination part/(cm2·min)	
			Minimum	Maximum
•	Installation are on roof of Turbine Hall, Elevation +35,50 (Axes 35-39)	22-50	100	700
•	Installation are on roof of ДЭ Elev. +42,80 (Axes 35-37)	30-32	100	700
•	Installation are on roof Elev. +55,00 (Axes 36-38)	40-200	100	700
•	Installation are on roof of Unit B Elev. +71,20 (Axes 36-39)	250-1200 (there is a local increase of EDR up to 1200 mR/hr along Row E, Axes 36-37)	50	4500
•	Installation are on roof of Unit B Elev. +74,50 (Axes 36-39)	200-500 (there is a local increase of EDR up to 1000 mR/hr in Rows M-H, Axis 38-39)	50	4500
•	Installation are on roof of Unit B Elev. +67,50 (Axes 36-39)	190-600	50	4500
•	Installation are on roof of NIAS Elev. +26,30 (Axes 36-39)	28-30 (along northern wall of Unit B from Elev. +26,30 to Elev. +67,00	200	2700

#	Installation Area	EDR, mR/hr	Removable beta-contamination part/(cm2·min)	
			Minimum	Maximum
		EDR increases up to 100 mR/hr)		
•	Installation are on roof of NIAS Elev. +22,36 (Axes 36-39)	15-35	200	1500

Eastern fencing structure of NSC per Table 3.3-1 will abut to the structures of the Turbine Hall and Deaerator Stack along Axis 64. Accordingly, the assumed working places for installation of the eastern fencing structure of NSC shall be located on the roof of Turbine Hall and Deaerator Stack along Axes 64-68.

On the roof of the Turbine Hall the EDR varies from 0.2 to 4.0 R/hr; the highest values are recorded along Axes 50-58 in the central part of the roof. In the installation area of the eastern fencing structure of NSC on the Turbine Hall roof EDR varies from 1.0 to 3.0 R/hr.

On the roof of the Deaerator Stack along Axes 52-55 the capacity of gamma-radiation reached 0.2-1.0 R/hr. In the locations of abutment of the eastern fencing structure of NSC the EDR values constitute 0.2 – 0.6R/hr.

At present, the information related to the radiation conditions on the roofs of the Turbine Hall and Deaerator Stack is incomplete and out-of-date. Enough time passed from the moment of conduction of the last measurements and the radiation fields might have changed drastically. Thus, aiming at adequate analysis of planned dose loads of the personnel, development of the design solutions and measures of radiation protection it is necessary to organize the additional investigations of the radiation situation. These investigations shall include mandatory analysis of the shielding measures of the working areas.

3.4.6 FORECAST OF RADIATION CONDITIONS CHANGE DURING DECONSTRUCTION OF UNSTABLE STRUCTURES

When assessing the boundary conditions of the deconstruction (consideration of the necessity of the radiation protection measures for the personnel prior the deconstruction work start, installation of the shielding for certain areas assuming their zoning, etc.) the radiation situation changes have been assessed. The analysis considered the following basic assumptions:

a. The value of activity in the Central Hall: $5.4*10^{15}$Bq ^{137}Cs (1)
b. The value of activity under the roofing panels: $2.9*10^{14}$Bq ^{137}Cs (1)
c. Only ^{137}Cs is considered since it represents 99% of gamma-radiation;
d. The radioactivity levels have been measures in the points located in 10-30 m to the west from the western buttress wall, where the auxiliary facilities for deconstruction of unstable structures will be located.

Considering the fact that the period of half-decay of ^{137}Cs is 30.15 years, then, in 15 years the dose capacity will reduce on 30%, and in 40 years – on 50%. Table 3.4-12 shows the results of assessments. The positive values are presented for north, and negative – for south from the central plane.

Table 3.4-12. EDR in the Local Zone after unstable structures destruction

Distance from Axis 47 of Central Hall (m)	EDR (10^{-2}Sv/hr)		
	Distance from Buttress Wall		
	10m	20m	30m
All roofs of buildings are preserved, NSC created			
10	1.55E-03	1.85E-03	1.91E-03
0	1.55E-03	1.97E-03	2.15E-03
-10	1.43E-03	1.74E-03	2.00E-03
-20	1.89E-03	2.08E-03	2.23E-03
-30	1.52E-03	1.84E-03	2.14E-03
-40	1.60E-03	2.59E-03	2.73E-03
Roof panels are taken off, Central Hall roof is preserved, NSC created			
10	1.91E-03	2.49E-03	2.43E-03
0	1.91E-03	2.45E-03	2.75E-03
-10	2.14E-03	2.37E-03	2.64E-03
-20	2.13E-03	2.47E-03	2.85E-03
-30	2.22E-03	2.47E-03	2.72E-03
-40	2.35E-03	2.67E-03	3.09E-03
Roof panels are preserved, Central Hall roof is taken off, NSC created			
10	6.29E-03	7.36E-03	8.85E-03
0	5.81E-03	6.89E-03	7.49E-03
-10	5.75E-03	7.66E-03	7.75E-03
-20	5.31E-03	6.23E-03	7.12E-03
-30	5.25E-03	6.74E-03	6.65E-03
-40	5.14E-03	5.93E-03	6.55E-03
Roof panels are taken off, Central Hall roof is taken off, NSC created			
10	6.68E-03	7.74E-03	8.40E-03
0	5.98E-03	7.31E-03	8.63E-03
-10	6.70E-03	6.99E-03	8.41E-03
-20	7.17E-03	6.66E-03	8.26E-03
-30	5.62E-03	6.62E-03	7.47E-03
-40	5.43E-03	6.88E-03	7.64E-03

When implementing the deconstruction works the specific activity of aerosols may vary within the range from $3x10^3$ to $2x\ 10^4$ Bq/m^3. Under the utilization of dust suppression system these values will be reduced in two orders.

These assessments are preliminary; and these shall be revised during SAR development. After obtaining of more detailed information on the values of surface contamination and performance

of additional calculations, these values will be specified and used for development of radiation protection measures for the personnel to involved into OS operation at all the stages (commissioning and operation of NSC, deconstruction of unstable structures and further removal of FCM and RAW from OS).

3.5 RADIOLOGICAL CONDITIONS OF WORK IMPLEMENTATION IN THE LOCAL ZONE AND ON INDUSTRIAL SITE

Radiological conditions in OS local zone and on industrial site are periodically renewed. There data will be further updated as the work progresses in the local zone and on industrial site of OS. The Employer shall periodically inform NOVARKA on the change of radiation situation.

Radiation situation in the local zone and on industrial site is characterized by the following parameters:

- Dose rate of γ-radiation;
- Spatial and energy distribution of γ-radiation;
- Levels of total radioactive surface contamination with α- and β-radionuclides (only for OS industrial site since in the local zone of β-particles flux in the high EDR fields is not measured due to high error.
- Levels of removable/irremovable radioactive surface contamination with α- and β-radionuclides of equipment and facilities within the local zone and industrial site of OS;
- Radionuclide volume activity in the air.

Radioactive materials located inside the facility and in soil form radiological conditions in OS local zone and on industrial site. RAW buried within the local zone, radioactive soil and radioactively contaminated ground water are the major types of radioactive materials.

Characteristics of soil and ground water contamination in OS local zone and on industrial site and values of radiological parameters of NSC construction area [4.5.37] are presented below.

3.5.1 SOIL CONTAMINATION

Contamination of the ChNPP site soils and adjacent areas with radioactive substances is characterized by the following specific features:

- Relatively even contamination of area with fine dispersed fuel is observed;
- Single aggregations and uneven contamination of the same area with the core fragments, debris and graphite are found. The main mass of such fragments and debris are concentrated in the soil around the SO walls.

Construction debris and ruined reactor elements, which γ-radiation dose rate from surface exceeded 1R/h collected together with core fragments and upper soil layer in containers of 1 m^3 capacity were buried [5.1.5]:

- To the south of Turbine Hall along row A between axes 36-68 (containers with waste which EDR > 300 R/h);
- To the west of Turbine Hall along axis 68;
- To the north and west of Unit Б along row Ю and axis 51`.

Currently soil covering the area is divided conditionally into the following layers:

- Post-accident man-made layer;
- “Active” accidental;
- Before-accident man-made;
- Natural grounds.

Post-accident man-made layer of soil is generated in the result of the accident consequences liquidation and decontamination of the area. Its thickness in the Local Zone is predominantly, 1.7 m - 2.7 m, rarely 3.4 m - 6.5 m; it reaches 8.4 m - 10.1 m at the areas of 'Pioneer" walls construction.

"Active" accidental layer had been formed during the accident and in the course of its liquidation. Thickness of layer is 0.15 m - 0.30 m. Radiation contamination of this layer is the highest. Later the accident layer was fixed with concrete in the course of the Cascade Wall and Pioneer Wall construction and other protective facilities too.

Accident layer is presented by the crushed rock and sand with structure fragments, soil and concrete. Depth of the layer corresponds to the thickness of post-accident man-made grounds and is within an interval 113.5 m -115.5 m (according to BAS).

Before—accident man-made layers were generated in the course of the area layout and backfilling of the building foundation pits and communication trenches (after construction of ChNPP second commissioning stage buildings and facilities). Depth of the layer is predominantly, 104.0 m – 113.0 m, thickness - from 1 m to 8 m.

Before-accident man-made soils are presented as sands, clay sand and loams including wreckages of concrete, metallic objects, brick and other fragments of structures, macadam, and debris.

Nature grounds of OS area are alluvial sediments (section 3.1 of this document), which are presented by fine sand and sand of average fineness. Thickness of deposits above the underground water line reaches 2.5 m.

OS Local zone layer contamination is set forth in Table 3.5-1. Values of "active" layer EDR, obtained according to the results of the Local zone bore-hole logging are within the limits of 6 - 7000 mR/hour; here the highest values have been recorded near Cascade Wall and Buttress Wall [5.1.15].

Table 3.5-1. Specific activity of radionuclides in the Local zone grounds

GROUP OF GROUNDS	^{137}Cs, Bq/g	^{90}Sr, Bq /g	Uranium (U) Bq /g	^{238}Pu, Bq /g	$^{(239+240)}$Pu Bq /g	^{241}Am, Bq /g
Post-accident man-caused layer	0.2-570	0.2-70	0.2-8.0	0.0021-0.5	0.0038-1.0	0.0038-1.0
"Active" layer	1100-515500	2500-480000	1.6-2200	3.1-16000	1.7-30000	1.4-78
Before-accident man-caused layer	0.041-9500	0.051-17000	0.17-8.0	0.0004-130	0.00091-270	0.00071-1.0
Natural grounds	0.056-476	0.05-120	0.17-1.4	0.0012-1.6	0.0029-2.5	0.0035-1.8

Contamination of post-accident man-caused layer within the territory of the OS Local zone and Industrial site varies in the following manner:

- Specific activity of ^{137}Cs varies from 0.5 to 570 Bq/g, the highest values are determined at the northern site of the OS local zone. In "active" layer, the specific activity of ^{137}Cs^{137}Cs varies from 1100 to 87000 Bq/g, and on site adjacent to the cascade wall it reaches 515500 Bq/g;

- Specific activity of ^{90}Sr in “active” layer of the northern site of the Local zone varies from 2500 to 480000 Bq/g. At the rest of the territory the specific activity of ^{90}Sr does not exceed 640 Bq/g;
- Specific activity of ^{241}Am constitutes 0.0038 to 1.0 Bq/g, and in “active” layer of the soil it varies from 1.4 to 78 Bq/g.

Table 3.5-2 presents characteristics of radioactively contaminated soil in the area of NSC construction and access roads including RWTLS “Stroybaza” site (RAW temporary localization site).

Table 3.5-2. Characteristics of Radioactive Contaminated Grounds at the Site of NSC Construction

SITE NAME	SQUARE. HECTARES	RAW VOLUME	RAW ACTIVITY VALUE
RTWLS Site “Stroybaza”	3.9	9665 m^3	
Highway Line	6.5	66560 m^3	Total activity – 91.02 TBq. average specific activity 850 kBq/kg
The Southern Area of the Site	6.7	89100 m^3	Total activity – 232.84 TBq. Average specific activity of nuclides: ^{137}Cs - 730.8 kBq /kg. ^{154}Eu - 4.75 kBq/kg. ^{241}Am - 8.92 kBq/kg. $^{90}Sr+^{90}Y$ – 877 kBq/kg
Site Areas of the External Engineering Systems and Facilities	18.1	212600 t	Total activity – 37.6 TBq. range of average specific activity of nuclides: ^{137}Cs - 48.9 - 320.3 kBq/kg ^{241}Am - 0.25 - 4.1 kBq/kg ^{90}Sr - 0.2 - 64 kBq/kg
“Stroybaza” Area	20	230000 t	Total activity – 48.2 TBq. Average specific activity of nuclides: ^{137}Cs - 81.6 kBq/kg $^{238-240}Pu$ - 1.53 kBq/kg ^{241}Am - 1.21 kBq/kg $^{90}Sr+^{90}Y$ - 124.8 kBq/kg
Assembling Area for NSC and Access Ways	4.4	84500 t	Total activity – 1.56 TBq. Average specific activity of nuclides: ^{137}Cs - 65.8 kBq/kg ^{241}Am - 1.11 kBq/kg $^{90}Sr+^{90}Y$ - 115.8 kBq/kg

Figure 3.5-1 presents cartogram of NSC assembling area site [5.1.7].

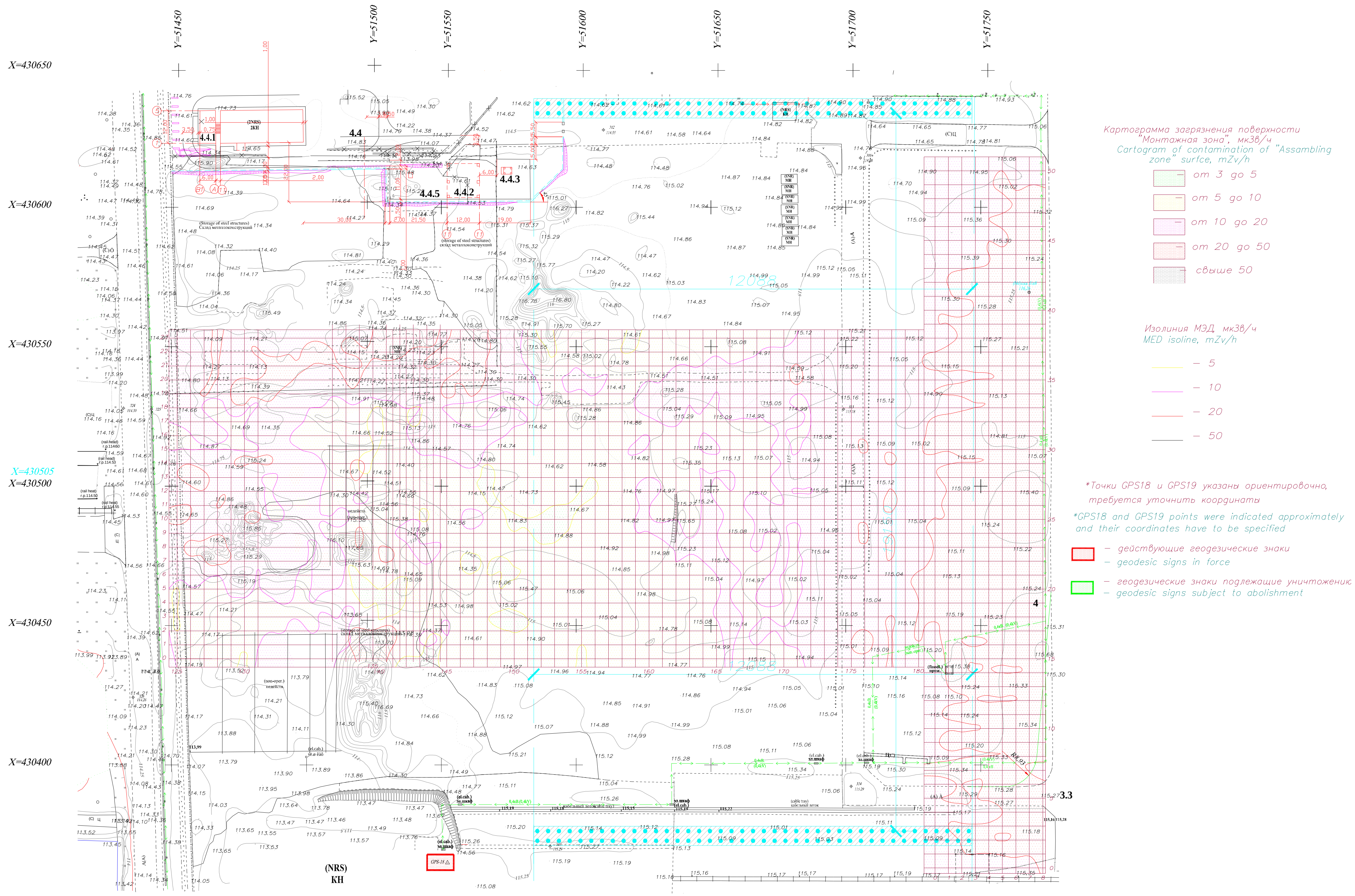


Figure 3.5-1. Cartogram of the OS Industrial zone assembling area

3.5.2 AIR RADIOACTIVE CONTAMINATION OUTSIDE OS

Air at the ground surface of the local zone and OS industrial zone is conditioned by uncontrolled aerosol releases through apertures of the OS light roof and walls. There is a direct dependence between radioactive aerosol release from OS and volume activity of air in the local zone.

Uncontrolled release from OS is made at the height of 50 m from the surface through apertures and cracks in the containment; and their total square comes to about 120 m^2. The highest radioactive concentration in the air pre-surface layer is registered at the distance of 40-50 m from the OS wall in the area of wind shadow (see Figure 3.5-2).

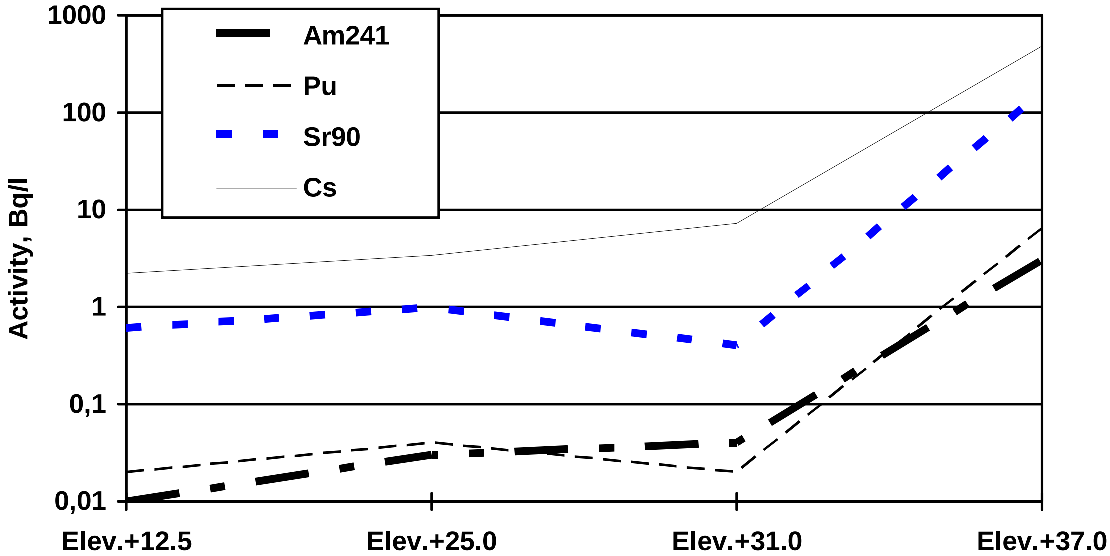


Figure 3.5-2. Altitude Dependence of Aerosol Volumetric Activity of Southern Area of Turbine Hall along axes 41-49

The volumetric activities of certain nuclides in air flows released through vertical reach-through holes of Turbine Hall vary in the following range:

- ^{241}Am – from $1.0{\cdot}10^{-5}$ Bq/m^3 to $1.6{\cdot}10^{-4}$ Bq/m^3;
- ^{244}Eu – from $1.0{\cdot}10^{-5}$ Bq/m^3 to $8.0{\cdot}10^{-5}$ Bq/m^3;
- ^{137}Cs – from $1.6{\cdot}10^{-3}$ Bq/m^3 to $2.93{\cdot}10^{-2}$ Bq/m^3.

Recently at OS a trend to stabilize the average annual values of uncontrolled radionuclide releases to the environment and subsequently stabilization of average annual values of radionuclide volumetric activity in the air of OS local zone and industrial site [4.5.1-4.5.8, 4.5.24] are observed.

Table 3.5-3 presents ratios of radionuclides in aerosol releases through technological locks of light roof and air of OS local zone.

Table 3.5-3. Ratios of Radionuclides in OS Aerosol Releases and Local zone Near-surface Air Layer as of 2005

PARAMETER	$^{137}Cs/^{154}Eu$	$^{137}Cs/^{241}Am$	$^{244}Eu/^{241}Am$
Ratio of radionuclides in power unit 4 "basic" fuel content (average for 2005)	131	45,0	0,339
Ratio of radionuclides in aerosols released from OS as of 2005	200± 30	57 ± 9	0,29 ± 0,06
Deviation of the ratio from design one, *% ("+" is above design on and "–"below design one)*	+ 53	+ 27	- 14
Ratio of radionuclides in near-surface layer aerosols as of 2005	140 ± 20	44 ± 9	0,31 ± 0,06
Deviation of the ratio from design one, *% ("+" is above design on and "–"below design one)*	+ 7	- 2	- 9

In 2007 the amount of uncontrolled releases of α- and β-aerosols through cracks and apertures at upper OS elevations were estimated by 7.3 MBq and 619 MBq correspondingly (for the period from the beginning of 2007 through 06.12.07) [4.5.9b]. The total amount of α- emitters includes isotopes (^{240}Pu + ^{239}Pu) + ^{238}Pu + ^{241}Am and the total amount of β-emitters includes isotopes ^{137}Cs+(^{90}Sr+^{90}Y)+^{241}Pu. During the first half of 2008 the amount of uncontrolled releases of α- and β-activity aerosols constituted 2.5 MBq and 286 MBq, correspondingly [4.5.37]

OS radioactive aerosols' release intensity and subsequently air contamination levels in the vicinity of OS, heavily depend on seasonal factors and meteorological conditions. In autumn and winter period aerosol release from OS and its volumetric activity in local zone are usually higher than in summer time and that is because of the airflow velocity from OS in autumn and winter period is higher than in summer time [4.5.3-4.5.8, 4.5.9b].

The intensity of release in 2007 coincides with the average value of uncontrolled release during similar periods in 2005-2006.

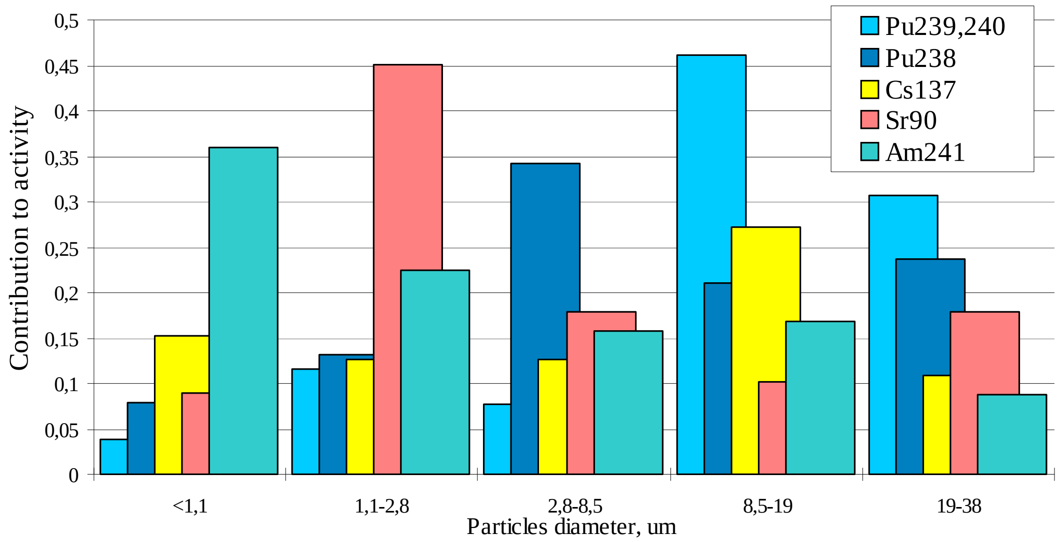


Figure 3.5-3. Activity of radionuclides in the uncontrolled release against aerosols dispersion

Figure 3.5-3 shows the contribution of certain radionuclides to activity of aerosols in uncontrolled release depending on aerosol dispersion. Figure 3.5-4 [4.5.7] presents the dispersion content of radioactive aerosols in the atmospheric near-surface layer of the sanitary protective area, OS industrial zone and local site and releases through vertical reach-through holes in Turbine Hall panels.

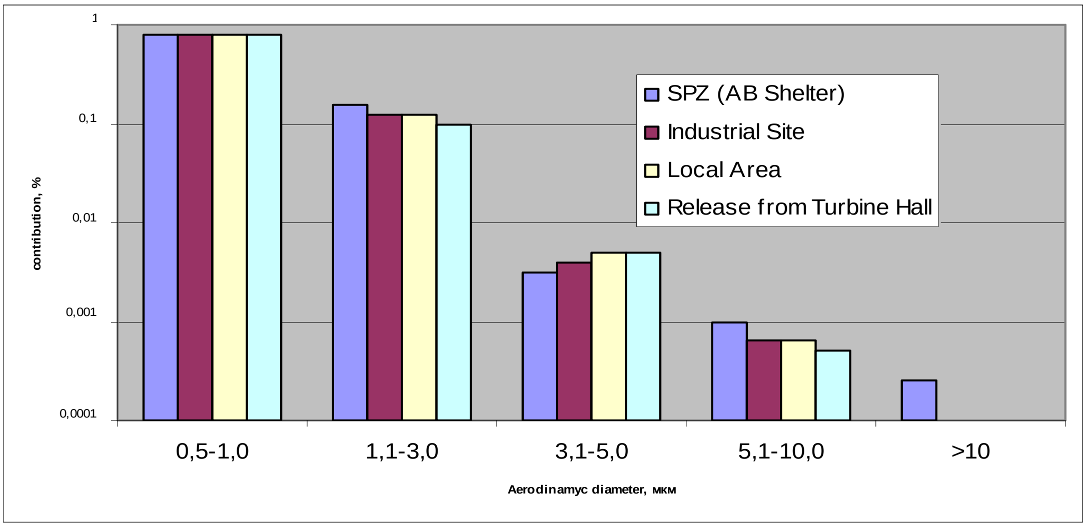
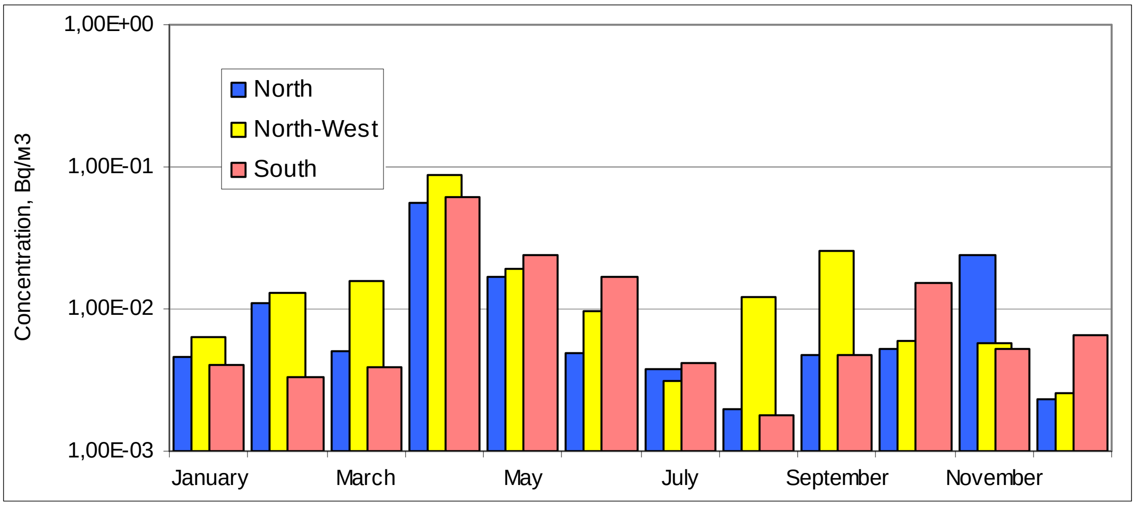


Figure 3.5-4. Radioactive Aerosol Dispersion Composition in Pre-surface Atmospheric Layer and Releases from Turbine Hall

The total contribution of radioactive aerosols released out of OS rooms to the total contamination level in the air of the local zone equals at least 70% [4.5.10].

The second major radioactive aerosol source in the near-surface air is the soil contaminated by radionuclides. Contribution of secondary dust suspension from the surface of OS industrial zone and surrounding areas to the near-surface atmospheric air contamination constitutes from 1% to 30%, depending on the meteorological conditions.

Figure 3.5-5 demonstrates the dependence of distribution of radionuclide volumetric activity in the near-surface atmospheric air on the air sampling points in 2007 (average data) [4.5.9b].



* - The sum of isotopes ^{137}Cs, ^{90}Sr, ^{90}Y, ^{241}Pu, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Am

Figure 3.5-5. Radionuclide Activity Distribution in the Air on the Industrial Site

The increased radioactive aerosol concentrations in the Southern area of the industrial site are influenced by the predominance of northwest wind in ChNPP area [5.3.14].

In summer, the values of aerosol volumetric activity at lower elevations (elevation +12.500 – the industrial site bedding surface) are comparable to the values of aerosol volumetric activity at higher elevations (elevation +36.000 – the open aperture) and that is stipulated by the effect of wind lift and aerosol transfer from the industrial site bedding surface.

In the periods of atmospheric precipitation fall and even if the OS aerosol release rate is high, the aerosol volumetric activity in the air of the industrial site and the local zone remain relatively low. Oppositely, when the weather is dry and windy even if the OS aerosol release rate is low, the aerosol volumetric activity in the air of the industrial site and the local zone can get higher due to secondary dust suspension from the surface.

Maximum and minimum values of aerosol volumetric activity in the air of the local zone during 2001 – 2007 are presented in Table 3.5-4 [4.5.24, 4.5.4-4.5.8, 4.5.9b].

Table 3.5-4. Values of Aerosol Volume Activity in the Air of OS Local zone in 2001 2007

YEAR	2001	2002	2003	2004	2005	2006	2007
α- Radionuclide Volumetric Activity, Bq/m^3	$3.7·10^{-4}$ - $1.22·10^{-2}$	$7.4·10^{-4}$ - $1.7·10^{-2}$	$1.4·10^{-3}$ - $2.8·10^{-2}$	$0.8·10^{-3}$ - $1.9·10^{-2}$	$5.2·10^{-4}$ - $1.0·10^{-2}$	$5.7·10^{-4}$ - $1.10·10^{-2}$	$7.6·10^{-4}$ - $1.3·10^{-2}$
β- Radionuclide Volumetric Activity, Bq/m^3	$3.7·10^{-2}$- 1.4	$3.7·10^{-2}$- 1.4	$1.7·10^{-1}$- 2.5	$2.1·10^{-2}$- 1.0	$2,0·10^{-2}$- 0.96	$1.9·10^{-3}$ - 0.21	$1.0·10^{-3}$ - $3.3·10^{-1}$

<u>Note</u>:

The sum of α-emitters includes isotopes $^{238+239+240}Pu$ + ^{241}Am;

The sum of β-emitters includes isotopes ^{90}Sr + ^{90}Y + ^{241}Pu + ^{137}Cs + ^{125}Sb + ^{134}Cs + $^{154,155}Eu$.

Tables 3.5-5 and 3.5-6 present results of monitoring aerosol volumetric activity in the air of certain facilities of the OS industrial site and local zone in 2007 [4.5.9b].

Table 3.5-5. Results of Monitoring of Volumetric Activity of α-aerosols in the Air of the Industrial Site in 2007

FACILITY	MAX VALUE Bq/m^3	MIN VALUE Bq/m^3	AVERAGE VALUE* Bq/m^3
OS Administration Building	$1.9\cdot10^{-3}$	$5.2\cdot10^{-4}$	$8.5\cdot10^{-4}$
OS Administration Building Area	$1.3\cdot10^{-3}$	$5.2\cdot10^{-4}$	$8.0\cdot10^{-4}$
DTCD ATB	$3.1\cdot10^{-3}$	$5.8\cdot10^{-4}$	$1.1\cdot10^{-3}$
DTCD ATB Area	$1.1\cdot10^{-3}$	$5.4\cdot10^{-4}$	$8.3\cdot10^{-3}$
Observation Pavilion	$9.1\cdot10^{-4}$	$4.1\cdot10^{-4}$	$6.6\cdot10^{-4}$
CAB Building	$1.3\cdot10^{-3}$	$4.9\cdot10^{-4}$	$7.2\cdot10^{-4}$
CF-1430 Building	$1.0\cdot10^{-3}$	$1.0\cdot10^{-4}$	$2.9\cdot10^{-4}$
CF-1430 Area	$1.5\cdot10^{-3}$	$5.2\cdot10^{-4}$	$7.5\cdot10^{-4}$
MLB (hall)	$1.0\cdot10^{-3}$	$3.5\cdot10^{-4}$	$7.4\cdot10^{-4}$
PTC (hall)	$1.3\cdot10^{-3}$	$4.8\cdot10^{-4}$	$7.5\cdot10^{-4}$

Table 3.5-6. Results of Monitoring of Volumetric Activity of □- aerosols in the Air of the Industrial site in 2007

FACILITY	MAX VALUE Bq/m^3	MIN VALUE Bq/m^3	AVERAGE VALUE* Bq/m^3
OS Administration Building	$1.2\cdot10^{-2}$	$5.7 \cdot 10^{-3}$	$7.5 \cdot 10^{-3}$
OS Administration Building Area	$3.0 \cdot 10^{-2}$	$6.4 \cdot 10^{-3}$	$9.7 \cdot 10^{-3}$
DTCD ATB	$2.5 \cdot 10^{-2}$	$6.8 \cdot 10^{-3}$	$1.1 \cdot 10^{-2}$
DTCD ATB Area	$1.1 \cdot 10^{-2}$	$4.2 \cdot 10^{-3}$	$8.0 \cdot 10^{-3}$
Observation Pavilion	$9.4 \cdot 10^{-3}$	$4.2 \cdot 10^{-3}$	$6.9 \cdot 10^{-3}$
CAB Building	$1.0 \cdot 10^{-2}$	$4.2 \cdot 10^{-3}$	$7.7 \cdot 10^{-3}$
CF-1430 Building	$9.5 \cdot 10^{-3}$	$5.2 \cdot 10^{-3}$	$7.5 \cdot 10^{-3}$
CF-1430 Area	$1.1 \cdot 10^{-2}$	$4.8 \cdot 10^{-3}$	$7.6 \cdot 10^{-3}$
MLB (hall)	$1.0 \cdot 10^{-2}$	$4.6 \cdot 10^{-3}$	$7.3 \cdot 10^{-3}$
PTC (hall)	$3.8 \cdot 10^{-2}$	$5.9 \cdot 10^{-3}$	$1.0 \cdot 10^{-2}$

* Note: the average value is defined as average weighted per time intervals of separate measurements.

The general tendency is retained within the last years on stabilization of the reached level of the air contamination in the OS local zone and industrial site. The level of air contamination in the peculiar point of OS territory is defined by the sum of natural and man-induced factors:

- Intensity of radioactive aerosols release from OS;
- Intensity and periodicity of atmospheric precipitation fall;
- Meteorological conditions (temperature, humidity, wind direction and velocity);
- Nature and intensity of the work under implementation.

Multi-annual monitoring of volumetric activity of radionuclides in the air during various operational and installation activities demonstrates the following [4.5.1-4.5.8, 4.5.9b]:

- Temporary increase in air radioactive contamination level in rooms have no effect on the total release from OS;
- Changes in radiological conditions during earthwork are of short-term nature.

3.5.3 PARAMETERS OF RADIOLOGICAL CONDITIONS IN OS INDUSTRIAL ZONE AND IN LOCAL ZONE

Figures A3.4-1 and A3.4-2 in Attachment 3.4 present cartograms of γ-radiation dose rates in OS local zone and industrial site as of 2008.

Tables 3.5-7 and 3.5-8 present EDR values at facilities of the local zone and industrial site of OS [4.5.8, 4.5.9]. The parameters of radiological conditions on the OS industrial site and in the local zone are updated based on the results of analyses of conducted within their territories measurements by SSE ChNPP and specific surveys performed by scientific and research certified in Ukraine for this type of activity. This data will be modified during the course of the works in the Local Zone and on the industrial site. The Employer is due to periodically inform NOVARKA on variations of the radiological situation before issuing unified access order.

Table 3.5-7. EDR Values at Off-site Facilities in the Local Zone

#	Number or Name of the Room or Building	γ-radiation EDR, mR/hr	Surface Radioactive Contamination, part./(cm^2×min)	Coordinates			Notes
				Elevation	Axis	Row	
1	Trailers of geodetic observation posts	5.0-5.5		+4.000	81	М-П	
2	Workshop of SOOS (NSC)	0,4-1,5	300 ÷ 1500 (there is individual spot contamination up to 10 000)	+4.000	78-81	Т''-С''	Subject to dismantling and transfer to OS Industrial site
3	Trailer of SOOS (NSC)	0,5-1,2	75 ÷ 180	+4.000	55-58	У''-Ю''	Subject to dismantling and transfer to OS Industrial site

#	Number or Name of the Room or Building	γ-radiation EDR, mR/hr	Surface Radioactive Contamination, part./(cm^2×min)	Coordinates			Notes
				Elevation	Axis	Row	
4	DSS	2.0 – 5.0		+12.000	78	Ф'-Д'	
5	Shed storage of SOOS (NSC)	2,5 ÷4,0 – на высоте 0,1м 2,0 ÷3,0 – на высоте1 м	200 ÷ 1000 (there is individual spot contamination up to 6 000)	+4.000	85	Д'	Subject to dismantling and transfer to OS Industrial site
6	Access control points-4, 5	0.4 – 1.0		+4.000		85	Subject to dismantling

Values of EDR within the major part of the local zone vary within the range from 2.0 to 20mR/hr. However, there are spots with higher EDR levels:

- To the west from foundations ФМ1 and ФМ2 in rows Л-М and axes 60-65 EDR increases to 30 mR/hr;
- At Deaerator Stack the local increase of EDR to 60 mR/hr (row Г Axes 62-63) and to 35 (row Г axis 58);
- Along southern buttress wall of the Turbine Hall EDR increases to 30 mR/hr;
- After development of Berm, the EDR values on its territory have been increased and are characterized by the following values: along axes 55-59 EDR varies within the range from 21 to 190 mR/hr, and along Axes 59-65 – 6.5 – 60.0 mR/hr.

Table 3.5-8. EDR Values at Off-site Facilities on the Industrial Site

№	OFF-SITE UTILITIES	γ-RADIATION EDR, mR/h
1	MD ATB	0.1
2	ASD ABK	0.09
3	ACP-13,14 and Pavilion	0.2 – 0.7
4	Access control point-15	0.4
5	ВК-3 sanitary lock	0,01 – 0,07
6	ВК-3 pumping unit	0.15
7	Graphite storage	0.9

Upon completion of works on deconstruction of buildings and facilities in the OS local zone and their transfer to the territory of OS industrial site the parameters of the radiation situation within its territory will change. At present the values of EDR at the major territory of OS industrial site

vary within the range from 0.8 to 3.0 mR/hr/ However, there individual sites with higher EDR levels:

- Along the southern perimeter of OS industrial site EDR varies within the range from 3.0 to 10.0 mR/hr (there is a spot of 12 mR/hr);
- Along the western perimeter of OS industrial site EDR increases to 4.5 mR/hr;
- Along rows S-J between Axes 128-144 (from west to east) EDR increases from 4.0 to 7.0 mR/hr.

The areas of assembly for the transferred from the OS local zone buildings and facilities include south-eastern (closer to buildings of Access Control Points-4, 5) and north-western parts of SO industrial site. These zones do not affect the sites with increased EDR levels.

Within the nearest time on the territory of the local zone and partially of the industrial site of OS the works on arrangement of pits for NSC foundations construction. The design foresees the following coordinates of the foundations:

- Northern foundation band is limited with coordinates (X1; Y1) = (430642,87; 51700,5), (X1; Y2) = (430642,87; 52074,0) , (X2; Y2) = (430628,37; 52074,0) и (X2; Y1) = (430628,37; 51700,5).
- Southern foundation band is limited with coordinates (X3, Y3) = (430382,43; 51700,5), (X3, Y4) = (430382,43; 52074,0) , (X4, Y4) = (430367,93; 52074,0) и (X4, Y3) = (430367,93; 51700,5).

Northern and southern bands of the NSC foundations partially enter the OS industrial site territory, which requires deconstruction of the fence of guarded perimeter of the OS local zone located on the sliding ways. Besides, buildings of Access Control Points – 4, 5 will be the subject to deconstruction.

The Employer performed the investigations of the parameters of radiological conditions along the northern and southern bands of NSC foundations. During investigations, EDR values were measured at the distance of 1 m from the surface of the soil with the set step along northern and southern bands of NSC foundations. Since high levels of EDR are available, which have uneven distribution, at the site of Berm development the measurements have been performed at more precise network (1m X 1m). The results of measurements and analyses of parameters of radiological conditions along the northern and southern bands of NSC foundations are presented in Table 3.5.9.

Table 3.5-9. Values of EDR along northern and southern bands of NSC foundations

DESCRIPTION	EDR VALUES,mR/hr	AVERAGE EDR VALUES, mR/hr
OS Industrial Zone		
Northern band of foundations (part on OS industrial site)	14 points with EDR values from 0,5 to 0,9	Average on 14 points: 0,67
Southern band of foundations (part on OS industrial site)	14 points with EDR values from 0,7 to 1,6	Average on 14 points: 1,11
OS Local Zone		
Northern band of foundations (part along axes 37-46)	6 points with EDR values from 2,0 to 4,5	Average on 6 points: 3,08
Northern band of foundations (part along axes 37-46)	6 points with EDR values from 2,0 to 4,5	Average on 6 points: 3,08

DESCRIPTION	EDR VALUES,mR/hr	AVERAGE EDR VALUES, mR/hr
Northern band of foundations (part along axes 46-55)	7 points with EDR values from 3,0 to 17,0	Average on 7 points: 5,71
Northern band of foundations (part along axes 55-64)	8 points with EDR values from 2,5 to 4,0	Average on 8 points: 3,25
Northern band of foundations (part along axes 64-72)	6 points with EDR values from 2,5 to 3,0	Average on 6 points: 2,67
Southern band of foundations (part along axes 37-44)	12 points with EDR values from 4,0 to 9,0	Average on 12 points: 5,96
Southern band of foundations (part along axes 44-55)	15 points with EDR values from 4,5 to 15,0	Average on 15 points: 9,63
Southern band of foundations (part along axes 55-59)	400 points with EDR values from 21,0 to 190,0	Average on 400 points: 73,56
Southern band of foundations (part along axes 59-65)	109 points with EDR values from 6,5 to 60,0	Average on 109 points: 20,84
Southern band of foundations (part along axes 65-75)	15 points with EDR values from 4,0 to 12,0	Average on 15 points: 8,01
Northern band of foundations (part along axes 72-80)	8 points with EDR values from 1,5 to 2,5	Average on 8 points: 2,0
Northern band of foundations (part along axes 80-89)	9 points with EDR values from 0,6 to 2,0	Average on 9 points: 1,13
Southern band of foundations (part along axes 75-82)	6 points with EDR values from 3,0 to 7,5	Average on 6 points: 4,7
Southern band of foundations (part along axes 82-89)	9 points with EDR values from 0,9 to 3,0	Average on 9 points: 1,84

Pre-design studies of the local zone and industrial site were conducted in 2004 to obtain input data for development of design documentation for NSC construction [5.3.13]. Data on spatial, angular and energy characteristics of γ-radiation fields in two work areas were received as a result of the studies (Figure 3.5-6):

- The Arch assembling area (area 1) is of rectangular shape located 120 m-265 m away from Buttress Wall westwards;
- Technological facility construction area (area 2) is of rectangle shape located 60 m-120 m away from Buttress Wall westwards.

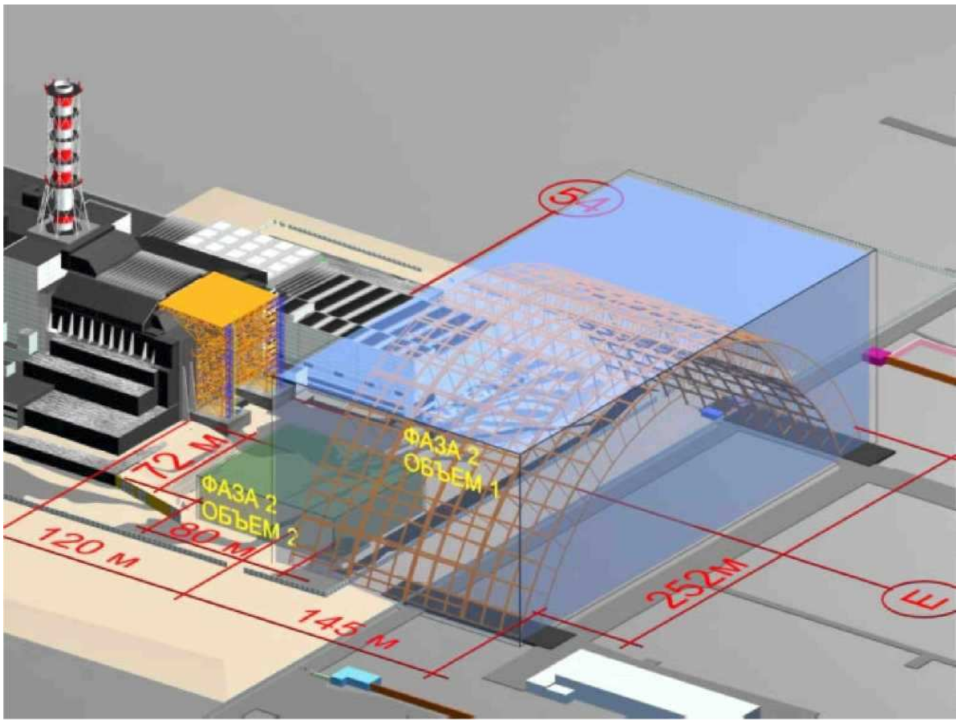


Figure 3.5-6. Location of Study Areas under NSC Project in OS Local Zone and Industrial Site

The γ-radiation sources at the selected areas are the following:

- Fuel containing materials located in OS;
- Radioactively contaminated man-made layer and "active" soil layer;
- Surface radioactive contamination of different equipment and structures;
- Areas of temporary storage of radioactive materials (kerns, operational RAW, etc.);
- Dispersed radiation (in this case it denotes γ-radiation from the listed sources, which underwent dispersion in the surrounding space).

The characteristics of those sources and their contribution to the radiological conditions are different at specified areas, provided no shielding is present; however the following conclusions are made based on the analysis results:

- The effect of OS sources and their contribution to the radiological conditions decreases with increasing distance from the facility, provided that there is no shielding;
- Effect of the man-made and "active" layers at different areas varies and that is due to either presence or absence of inclusions (contaminated structures, etc.), where contamination is significantly higher than the soil. Besides, thickness of the man-made layer, which covers "accident" layer is different;
- Surface contamination, which is specific of OS industrial site, is of low contribution to the radiological conditions however the relative portion of their contribution increases away from OS and that is due to the decreasing effect of other sources;
- Contribution of dispersed radiation to the radiological conditions increases away from OS due to so-called "umbrella" effect caused by the long way of γ-quanta free run in the air and minor dispersion angles;

- γ-radiation effective energy decreases away from the facility due to decrease in radiation spectrum, which is the result of quantum dispersion in the air.

Dose rate measurement in area 1 (volume 1) was performed by horizontal grid of 18×18 m and 10-m mesh by height. Maximum height of 226 m BAS in area 2 (volume 2) was received by horizontal grid of 18×18 m and 10-m mesh by height. Maximum height is 156 m BAS.

Tables 3.5-9 – 3.5-11 provide the results of EDR measurements in volume 1 and 2. Table 3.5-10 provides average of dosimeter recordings and acceptable measurement bias results for each measurement point. Table 3.5-11 provides average of dosimeter recordings for each measurement point. Heights are indicated relatively to the basic level in OS local zone (+116 m BAS). Relative errors of average DR estimates do not exceed 20 %.

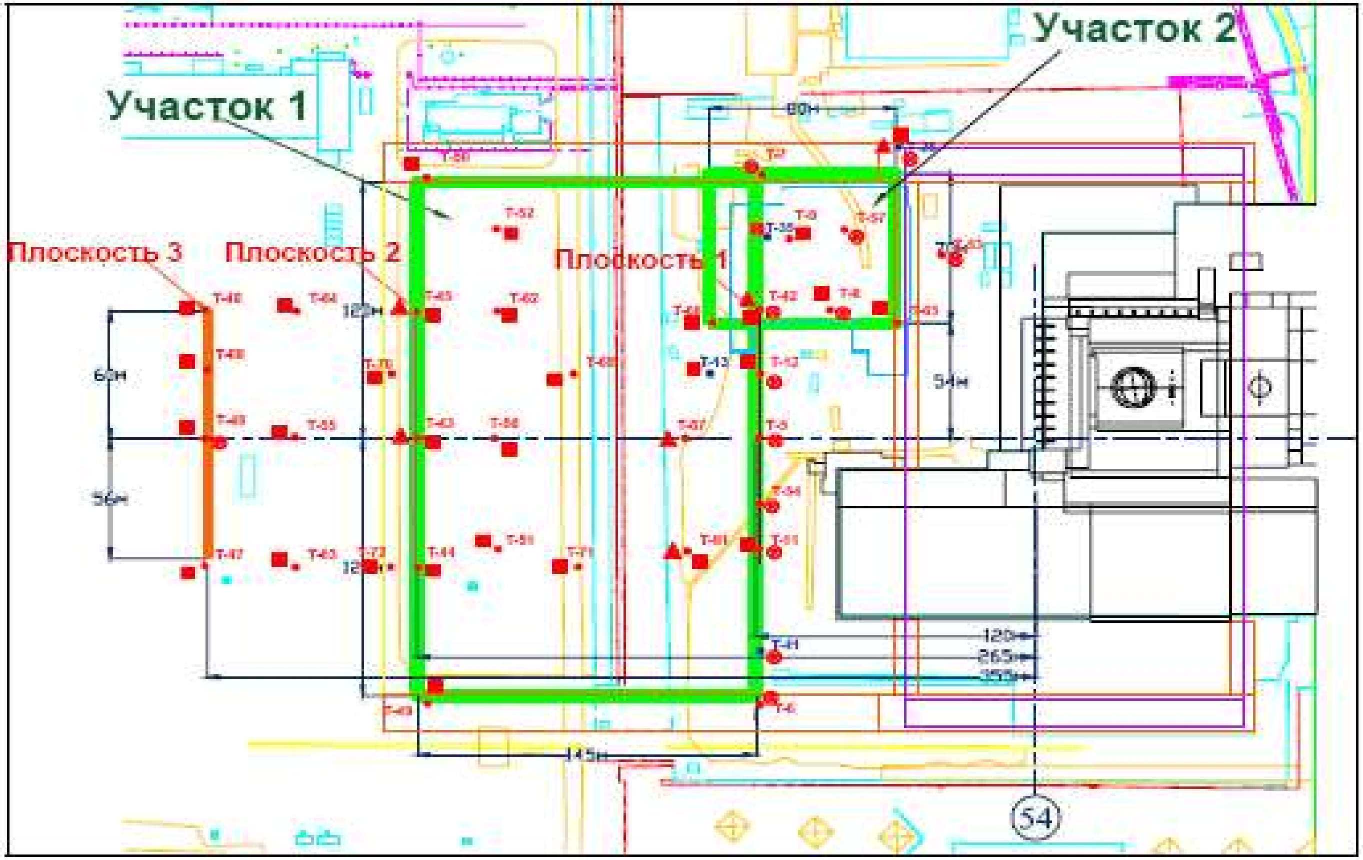
Based on the results of measurements decision was made that γ-field in volume 2 is insignificantly differentiated. The exception is the southeast part nearby points № 1-3, 6-8 and 11-13, which are characterized by the highest vertical and horizontal γ-field gradients. The maximum EDR value is 28.4 mR/h.

The minimum EDR values were detected in the northwest part of the volume and fall in the range of 3.4 - 10 mR/h. Major source, which forms γ-radiation in that volume is located in the direction east - southeast.

γ-field in volume 1 is also insignificantly differentiated. The exception is the volume at points №5, 35 and 50, which are characterized by the highest vertical and horizontal γ-field gradients. The maximum EDR values reach 60 mR/h.

The minimum EDR values were detected in the west part of the volume (beyond the local zone) and fall in the range of 1.3-10 mR/h. EDR values reach 11-16 mR/h at height of 70 m and higher.

Calculation of changes in γ-radiation dose rates was made during the pre-design study for NSC construction site. As a result of the calculations conclusion was made that by 2011 dose rate intensity due to natural nuclide decay will reduce approximately by 16 %.



• - area of measurement: ■ - «Screen», ⊗ - ШД-1, ▲ - СЕГ-04К

Figure 3.5-7. Location of Angular Distribution Measurement Points

Table 3.5-10. Values of γ-radiation Dose Rates in Volume 2

POINT №	AVERAGE VALUES OF γ-RADIATION DOSE RATE AT DIFFERENT HEIGHTS, mR/h			
	126 m	136 m	146 m	156 m
1	18.2 ±1.7	20.0±1.7	28.1±0.8	28.4±2.2
2	12.1 ±1.6	15.6±1.0	23.6±1.0	23.6±1.0
3	10.6 ±1.7	12.3±1.2	18.0±1.0	18.1±1.1
4	9.0 ±1.6	8.9±0.7	12.5±0.8	12.5±0.8
5	8.2 ±0.5	8.3±1.1	11.1±0.8	11.1±0.8
6	15.3 ±1.6	16.8±1.0	21.7±1.9	21.7±0.8
7	12.3 ±1.0	13.2±1.3	18.2±1.7	18.8±1.7
8	10.0±0.8	10.3±1.3	12.2±1.0	12.5±0.8
9	7.9±1.0	7.7±0.6	11.1±0.8	11.1±0.8
10	7.3±1.3	7.6±0.5	9.1±0.9	9.1±0.9
11	12.6±2.1	14.1±2.1	16.8±0.9	16.7±1.0
12	9.7±1.0	12.1±1.5	14.7±1.0	14.8±0.9
13	9.7±1.0	10.2±1.2	11.4±1.2	13.1±1.5
14	7.6±0.8	7.9±1.0	8.2±0.8	9.5±0.8
15	6.2±1.0	7.1±1.1	7.2±1.3	8.4±1.2
16	11.5±1.5	11.8±1.7	13.4±1.0	15.3±2.1
17	9.6±0.6	10.5±0.9	12.6±0.8	12.3±0.8
18	7.4±1.0	8.4±1.1	9.4±1.0	9.8±1.2
19	6.8±0.8	7.4±0.9	8.6±1.7	8.8±0.8
20	6.0±0.7	5.9±0.8	6.3±0.5	6.4±1.6
21	6.9±0.9	8.6±0.9	10.7±1.1	11.2±1.1
22	7.9±0.6	8.1±1.0	10.1±0.5	9.2±0.6
23	6.8±1.1	7.6±1.2	9.6±0.9	8.8±0.8
24	5.2±1.0	5.7±1.1	7.1±0.7	7.1±0.7
25	3.4±0.4	4.7±0.8	6.3±1.0	5.6±1.1

In general, EDR values tend to increase in height and decrease away from OS westwards. The major source, which forms γ-radiation in that volume, is located in the southeast direction (in the upper part of unit Г on axes 49-52, rows Б-В).

The γ-radiation sources, which significantly contribute to γ-field formation, are located in the southern part of volume 1 in row A.

Studies for angular distribution (Attachment 3.5) revealed the following radiation sources:

- Sources located in the middle part of Western Buttress Wall northwards of the Arch axis. Sources located in the stairwell/hoist area are of lower intensity but are quite significant ones;
- The evident effect of sources located on the Turbine Hall roof is observed in the centre of the Arch and southwards;
- Radiation intensity decreases away from OS and the facility itself relative to work areas located in the western part of the OS industrial site can be considered as the single significant radiation source. However, the increase in height reveals the effect of two major sources located in the areas of stairwell/hoist and Turbine Hall roof;

- Local sources were detected in the following directions: northwards (point 25) and westwards (point 12) of the local area fence, to the foundation of drilling equipment storage (point 35 and point 42), to the ramp embankment at the entrance to Pioneer Wall, axis A (point 6).

Table 3.5-11. Values of γ-radiation Dose Rate in Volume 1

POINT №	AVERAGE VALUES OF γ-RADIATION DOSE RATE AT DIFFERENT										
	126 m	136 m	146 m	156 m	166 m	176 m	186 m	196 m	206 m	216 m	226 m
1	9.0	11.1	12.9	15.5	22.0	27.4	32.4	35.0	45.2	45.2	49.8
5	14.5	17.9	24.6	34.5	45.2	47.5	47.3	48.2	55.4	59.7	57.6
10	13.0	13.3	15.7	17.5	19.8	30.2	31.9	32.6	29.3	29.1	27.7
15	6.0	5.9	6.3	6.4	10.2	11.1	11.2	12.8	12.8	11.9	11.6
20	12.0	13.2	17.1	28.2	33.6	37.7	36.2	37.0	33.5	33.0	32.3
25	8.6	10.9	12.7	13.2	18.3	19.8	20.3	20.6	23.8	26.1	25.9
30	3.6	5.0	5.9	6.1	6.5	8.2	8.5	10.6	11.0	11.4	11.3
35	9.8	11.4	12.6	15.3	21.7	25.6	25.5	25.1	25.1	27.1	27.3
40	6.9	8.7	9.8	11.9	11.7	12.9	13.9	15.4	19.1	20.4	22.4
45	3.6	4.8	5.0	5.3	5.5	6.0	6.2	7.1	9.8	9.7	10.8
50	6.4	7.9	8.9	10.8	14.2	15.6	17.0	17.8	22.2	22.1	22.0
55	6.3	7.2	7.0	9.0	11.1	12.1	12.4	16.6	18.5	19.6	20.1
60	3.2	3.6	4.4	4.5	5.4	6.2	6.4	6.5	6.8	7.1	7.6
65	5.4	6.1	7.6	9.2	9.4	12.6	13.7	15.0	16.4	15.3	15.2
70	5.5	5.5	6.0	6.2	6.5	8.4	8.6	8.2	10.8	11.8	11.9
75	3.3	3.6	3.8	3.7	4.5	4.7	4.8	5.4	5.8	6.2	5.6
80	5.7	5.9	6.1	6.7	7.1	8.5	8.7	11.0	11.6	12.5	11.8
85	3.8	4.6	5.3	5.9	5.4	6.3	6.1	6.2	6.4	6.8	6.6
90	2.3	2.8	2.9	3.1	3.4	3.6	3.9	4.4	4.9	4.8	4.6
95	3.6	3.9	4.0	4.3	6.2	6.6	7.8	8.3	8.9	10.0	9.8
100	2.7	3.3	3.8	4.5	4.6	4.8	5.3	5.4	6.3	6.9	6.4
105	2.2	2.6	2.8	3.0	3.1	3.3	3.6	4.0	4.4	4.7	4.8
110	2.8	3.0	3.2	3.4	4.0	4.6	4.8	5.2	5.9	6.5	6.2
115	2.8	2.9	3.1	3.3	3.4	3.8	4.2	4.5	4.7	5.4	5.1
120	1.7	1.9	2.0	2.3	2.4	2.7	3.0	3.6	3.7	3.9	3.6
125	2.2	2.3	2.3	2.4	2.6	3.1	3.2	3.6	3.5	4.2	4.1
130	2.2	2.2	2.4	2.4	2.4	2.5	2.7	3.4	3.8	4.2	4.0
135	1.4	1.6	2.0	2.1	2.3	2.3	2.6	2.5	2.9	3.1	3.1

Analysis of the study for energy characteristics (Attachment 3.5) demonstrates the following:

- Effective γ-radiation energy in the subject areas decreases from 370 keV (axis 54_{+1200}) to 320 keV (axis 54_{+3550});
- Spectra get more “hard” behind the lead shielding and consequently it increases effective energy from 250 keV to 500 keV and higher.

Bioshielding modelling made it possible to determine experimentally the ratio of γ-radiation attenuation by lead shielding:

- Shielding of directions towards major sources by lead shielding of 7.5 mm thick reduces dose rate value by 1.7 – 2.4 times. Increase of shielding thickness by 15 mm and higher is of no significant benefit of strengthening shielding effect;
- Shielding of two directions simultaneously (eastwards and southwards) is rational to apply only in the southeast part of NSC construction site.

The above studies were performed in 2004 before construction of metal structures of strengthening under Stabilization Measure #2. The angular distributions of gamma-radiation forming the EDR within the territory of OS industrial site and local zone (Fig. A3.5-5 and A3.5-6) show that one of the basic directions forming the EDR are the directions from FCM accumulations in the Central Hall of Unit 4 and hoisting block of Deaerator Stack. At present these directions may be partially shielded by the metal structures of strengthening providing for the EDR levels reduction at upper elevations of assumed zone of NSC sliding. Due to this at the stage of pre-design studies repeated research of altimetric distribution of EDR levels in the assumed NSC sliding area is required aiming at specification of certain features of EDR fields.

3.5.4 GROUND WATER CONTAMINATION OF THE INDUSTRIAL SITE

Around OS there is sample borehole system for hydro geological monitoring system intended for monitoring of potential leaks of radioactively contaminated water from OS rooms and the debris located under Cascade Wall to ground water. 23 boreholes and 3 measurement points on OS industrial site and 15 boreholes at OS adjacent area are used for monitoring level, hydro chemical and radiochemical modes of ground water.

Figure 3.5-8 presents the arrangement of boreholes and wells in OS local zone. Table 3.5-12 presents major characteristics of boreholes located in OS local zone [5.3.14].

Table 3.5-12. Major Characteristics of Boreholes in OS Local Area

№	BOREHOLE NUMBER	ABSOLUTE ELEVATION OF MOUTH, m	DIAMETER mm	ABSOLUTE ELEVATION OF FILTER, m	h_P, m	h_M, m
1	1-1Ам	117.21	20	109.26 - 108.86	-2.14	1.96
2	5-1А	121.24	89	101.74 - 100.74	-9.96	-5.86
3	6-1А	123.68	89	92.68 - 91.68	- 19.02	- 14.92
4	7-1А	123.87	89	104.87 - 103.87	-6.83	-2.73
5	9-1А	117.13	89	102.67 - 101.67	-9.03	-4.93
6	10-1А	119.91	89	106.31 - 105.31	-4.39	-0.29
7	13-1А	116.30	108	105.30 - 104.30	-6.40	-2.30
8	14-1А	116.60	108	109.60 - 108.60	-2.10	2.00
9	2-Г	116.67	108	107.67 - 106.67	-4.03	0.07
10	3-Г	116.60	108	108.90 - 107.90	-3.25	0.85
11	4-2Н	117.29	127	112.81 - 112.21	1.91	6.01
12	4-1Нм	117.29	20	110.50- 110.10	-1.30	2.80

№	BOREHOLE NUMBER	ABSOLUTE ELEVATION OF MOUTH, m	DIAMETER mm	ABSOLUTE ELEVATION OF FILTER, m	h_P, m	h_M, m
13	4-4Нм	117.29	20	109.76 - 109.26	-1.69	2.41
14	6-4Нм	116.88	20	110.33 - 109.93	-1.07	3.03
15	С-3	117.17	133	104.17 - 102.17	-	-
16	С-11	115.53	133	102.53 - 100.53	-	-
17	С-24	114.93	133	101.93 - 99.93	-	-
18	П-6	115.37	76	105.87 - 101.37	-	-
19	П -40	116.35	76	105.55 – 102.05	-	-

Note:

h_P – *difference of the filter position against the reactor unit foundation elevation;*

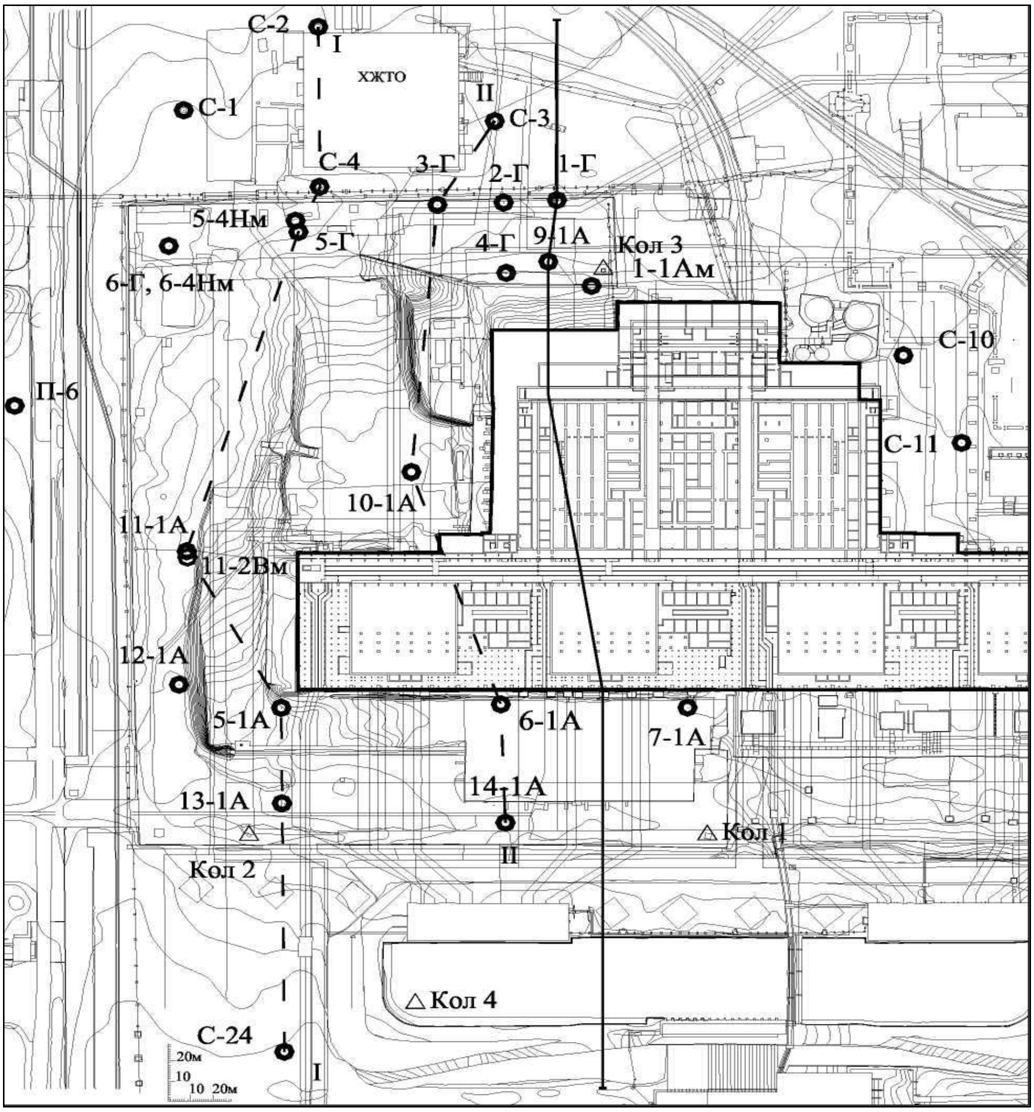
h_M — *difference of the filter position against the Turbine Hall foundation bottom*

The general direction of ground water flows in the vicinity of OS is south-north towards the flood lands of Pripyat River.

Fluctuation of ground water level (GWL) during calendar year is of distinct seasonal nature [4.5.37]. Figure 3.5-9 [4.5.9b] presents dynamics of GWL changes in group Г bore holes in 2007.

GWL absolute elevations in the local zone through 2005 (by group Г bore holes) fell in the range of 109,81 m to 110,24m.

Ground water contamination on OS industrial site first of all is stipulated by radionuclide migration from the surface but not “unit” water accumulation inside OS. However, there is a possibility of draining ground water through lower OS rooms [5.1.10, 4.5.1, 4.5.10, 5.3.14]. Nevertheless, the existence of hydraulic connection between water in rooms and ground water has not been thoroughly justified yet [4.5.34].



9-1A – borehole and its number △ Well 1 – well and its number
−−−− - hydrological cut line ------ - hydrological cut line and its number

Figure 3.5-8. Layout of boreholes and wells in the Local Zone of the Shelter

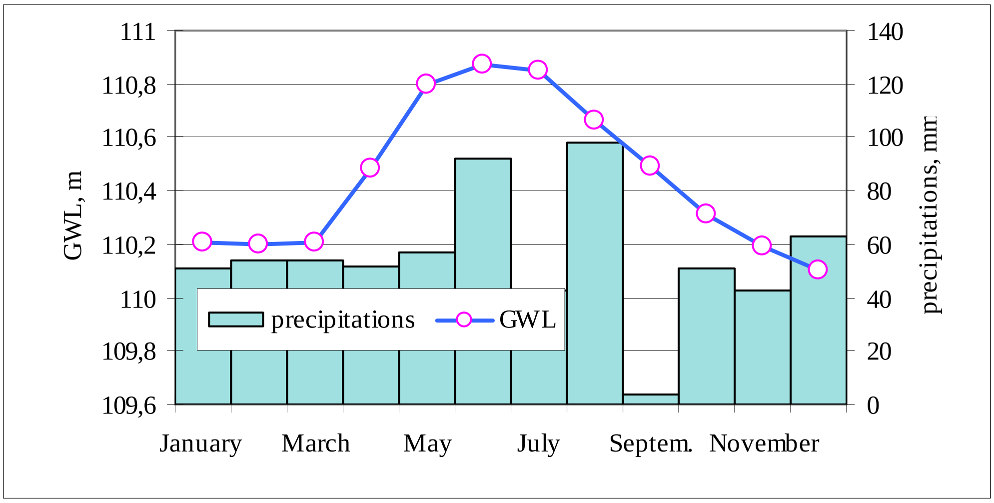


Figure 3.5-9. Dynamics of GWL change in bore-holes of group «Г» in 2007

A number of OS/Unit 3 rooms are located below ground water level (from 2 m to 4 m); besides, there are prerequisites for ingress and accumulation of ground water in ruined Unit 4 rooms and conditions of water infiltration from the rooms located above ground water level and ones, where "unit" water is accumulated.

Foundations of NIAS (~ at 4.3 m) and Turbine Hall (~ at 2.4 m), floors of certain NIAS rooms such as room 0001 (~ at 2.5 m) and room 0005 (~ at 3.7 m), Turbine Hall/Deaerator Stack such as room Г079/1-6 (~ at 1.43 m) and room Г074/12-14 (~ at 3.0 m) are located below GWL.

Considering the floor level in those rooms against GWL one can assume that under specific conditions such as floor permeability or micro cracks, etc. ground water flow is possible. In the meantime, such status of ground water level entirely prevents "unit" water from flowing to ground waters.

Floor in room 001/3 is above GWL by 1.2m; that room accumulates the most considerable amount of water, so it is not inconceivable that "unit" water would flow from that room to ground water. Flow of ground water to "unit" water in room 001/3 is absolutely impossible [4.5.33].

Ground water contamination by radionuclides through group Г bore holes is periodically monitored once a month; as to other holes radiohydrogeological monitoring is carried out once in a quarter.

In 2007 ground water mineralization on OS industrial site did not substantially changed in comparison with the previous years. Maximum general ground water mineralization constituted 534.5 mg/l (hole 6-Г) in 2007 [4.5.9b].

Maximum ion content in ground water constituted the following concentration:

- Na^{+} - 126.2 mg/l (hole 4-2Г);
- K^{+} - 74.5 mg/l (hole 1-2A);
- Ca^{2+} - 50.5 mg/l (hole 1-3A);
- Mg^{2+} - 10.7 mg/l (hole -3A);
- Cl^{-} - 57.4 mg/l (hole 4-2Г);
- NO_3^{-} - 35.1 mg/l (hole 1-2A);
- SO_4^{2-} - 201.7 mg/l (hole 6-Г);

- HCO_3^-- 208.7 mg/l (hole. 10-1A).

Radiochemical analysis of ground water is performed to determine volumetric activity of ^{90}Sr and ^{137}Cs as the ones of the highest migration property, and ^{3}H and ^{238,239,240}Pu as well.

Radiochemical composition of ground in 2007 against the previous years did not significantly change. Maximum nuclide activity was observed in holes 4-*Г* on ^{90}Sr and 13-1A on ^{137}Cs:

- By ^{90}Sr – 1036,41 kBq/m^3;
- By ^{137}Cs - 6.7 kBq/m^3.

Figure 3.5-10 presents the distribution of radionuclide volumetric activity by hydrogeological profile in the direction of north-south within OS local zone in 2007.

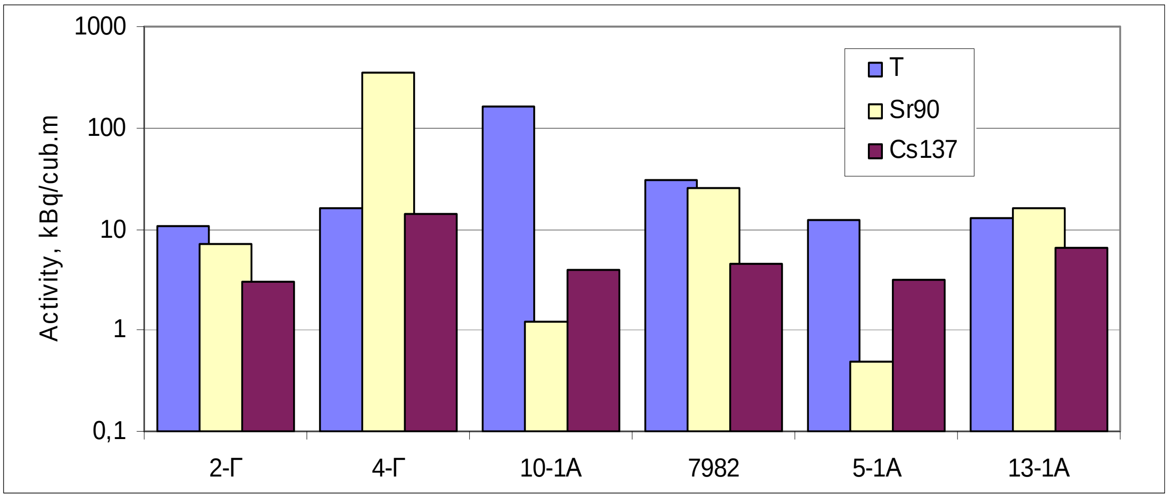


Figure 3.5-10. Spreading of values of radionuclides volumetric activity on the line of hydro-geological structure aside "North-South" within the OS Local zone in 2007

Average values of volumetric activity of ^{137}Cs and ^{90}Sr in ground water of the local area are presented in Table 3.5-13.

Table 3.5-13. Average Values of Volumetric Activity of 137Cs and 90Sr in Group Г Holes Water (2007)

HOLE NUMBER	^{90}Sr VOLUMETRIC ACTIVITY, kBq/m^3 (FILTRATE)			^{137}Cs VOLUMETRIC ACTIVITY, kBq/m^3 (FILTRATE)		
	CURRENT VALUES		REFERENCE CONCENTRATION	CURRENT VALUES		REFERENCE VALUES
	MAX	MIN		MAX	MIN	
1-Г	110.0	43.0	2000	5.5	1.4	1000
2-Г	7.8	1.8	200	2.2	0.72	300
3-Г	950.0	620	2200	9.1	1.2	1000
4-Г	1036.0	260.0	1500	7.4	1.2	1000
5-Г	2.3	1.0	200	6.8	0.60	300
6-Г	5.3	1.0	200	6.5	0.74	300

In general ^{137}Cs volumetric activity in ground water in the northern part of the local zone does not exceed the acceptable concentration $PC_{в}^{ingest}$ [2.1].

Uranium content in ground water in the northern part of the local zone varies from 0.1 to 1 mkg/dm^3. Such values are typical for background concentration of underground water beyond Uranium mines and are not significant from radiological point. Activity of transuranic isotopes ^{241}Am and $^{238-241}$Pu are the order lower than the activity of Uranium isotopes, which is also insignificant from radiological standpoint [4.5.34].

The values of ^{137}Cs volumetric activity in the ground waters in 2007 varied from 0.4 to 170 Bq/l (hole 7985). The tendency for increase of ^{137}Cs volumetric activity in the samples of ground waters from the holes around OS has not been observed.

Contents of ^{90}Sr in the ground waters in 2007 varied predominantly within the range from 0.1 to 1036 Bq/l. At this, the the largest values are observed at holes 4-Г (310 -1036 Bq/l) and 3-Г (770 - 951 Bq/l). During 2007 the volumetric activities of ^{90}Sr increased significantly in holes 9-3А (from 9 to 790 Bq/l) and 4-4н (from 63 to 670 Bq/l).
Contents of ^{137}Cs and ^{90}Sr in underground waters of Bucha artesian aquifer varied within 2007 in the range from 0,47 to 3,3 Bq/l amd from 0,5 to 1 Bq/l accordingly. The volumetric activity of ^{3}H in the samples of underground waters from hole 8024н constituted 4,2 -5,9 Bq/l.

In the surface waters within 2007 the values of volumetric activities of ^{137}Cs varied from 6,7 (Well-3) to 350 Bq/l (Well-1). The values of volumetric activity of ^{90}Sr varied from 3 (Well-2, Well -3) to 180 Bq/l (Well-1). Volumetric activities of ^{3}H in the samples of surface waters constituted 5 - 18 Bq/l.

There are operating and non-operating observation bore-holes in the Local Zone [5.1.6].

NOVARKA will carry out detail investigation of site, specify adequate layout of the bore-holes and possible obstacles. There are 4-6 bore-holes, which may be between sliding ways. They should be investigated, as a barrier for NSC construction works and operation. Final solution addressed to the bore-holes should be made together with ChNPP. Solution should take into account that some or all bore-holes are still utilized for programs of underground waters status monitoring. Necessity of removal and/ sealing of bore-holes to be closed should be also taken into account by the decision.

Contractor of the Working design should be acquainted thoroughly with Geotechnical Report and include requirement about preservation of bore-holes in satisfactory state into the investigation plan for support of the designed construction works.

3.6 INTERFACES BETWEEN NSC CS-1 SYSTEMS WITH THE OS AND CHNPP SYSTEMS

SIP projects on conversion of the OS into environmentally safe system (stabilization, reconstruction, modernization and technical re-equipment) are implemented simultaneously with the NSC design effort. Information on completed projects and systems of OS and ChNPP necessary for integration with NSC systems is contained in OS SSR [4.5.37]. Per the Contractor's request the Employer shall provide the available and necessary information related to the management of interfaces with the existing systems and systems developed by the other contractors. At present, per NOVARKA's requests large scope of information was transferred by ChNPP regarding interaction with OS and ChNPP systems NOVARKA shall analyze the sufficiency of the new information for the purposes of design and consider it during design effort. In case of insufficiency, NOVARKA shall issue additional requests. The information related to these projects will be submitted to NOVARKA on due time according to the Employer duties (see section 1.5). On the basis of this information, NOVARKA will be able to facilitate the integration of the NSC CS-1 systems during Design and assess the NSC safe conditions considering the OS as a component of the NSC and, in particular, the integration issues.

For the assessment of the interfaces between the OS systems and the NSC systems, list is given below of the systems which should be designed within the framework of the Detailed Design of the NSC. Division of systems according to their assignment is based on [5.1.16].

The Design of the NSC CS-1 assumes that all utilities and connections will be integrally operative over the whole NSC lifetime, providing, if required, adaptation, transformations or even reconstruction.

3.6.1 MAIN CRANES AND INDOOR TRANSPORTATION SYSTEM

This system encompasses the following items:

- Main cranes;
- Equipment for transportation and loading of operational RAW.
- Equipment for conveying freight and personnel to workplaces (lifts, protective boxes…).

None of them will interface with the OS and ChNPP systems.

3.6.2 PROCESS SYSTEMS

3.6.2.1 Solid radioactive waste management system

The NSC CS-1 SRAW management systems will be integrated within the existing OS and ChNPP SRAW management systems.

In particular, NOVARKA will provide equipment for collection, sorting, containerisation and transportation of SRAW inside NSC. The necessary information and initial requirements for such equipment, which should satisfy the ChNPP SRAW management system are given in [2.3, 2.16, 4.1.2, 4.2.1, 4.3.3, 4.3.6, 4.3.7, 5.2.10, 5.2.12].

The NSC RAW management system (receipt, temporary storage and dispatch to other facilities of ChNPP) will use the packages specified for RAW in ChNPP procedures 29-PS.

Waste packages with other dimensions which may be used for CS-2 and CS-3 will require adaptation of the dedicated management means. The modifications to the handling interfaces and other management means will be carried out by the contractors for these projects.

3.6.2.2 Liquid radioactive waste management system

The NSC CS-1 special sewage system will collect and temporary store the LRW produced by the CS-1 and CS-2 operations. Prior to any discharge to reception tank, the effluents will be analysed (sampling and analysis in ChNPP laboratory) to determine if they meet the LRW acceptance criteria on site. Employer shall provide NOVARKA with the criteria of maximum potential LRW contamination in NSC concurred by the RA, and information on the tie-in points of NSC special sewage with the ChNPP LRW handling systems, inclusive of installation for purification of effluents from the organic admixtures and TUE.

No specific water and effluent processing will be required in the NSC neither for CS-1 nor for CS-2. Furthermore, NOVARKA assumes that the processing building to be constructed on site for organic and transuranic removal from effluents will be operating and available before the start of NSC operations.

In the Design, NOVARKA will develop effluent transfer provisions consistent with the dedicated means available on site at the time of the NSC commissioning (mainly pipelines). Nevertheless connection will be provided in one of the truck garages to allow for effluent discharge into a mobile tank to be purchased by ChNPP.

The main sources of LRW generation when performing the works on NSC CS-1 construction will include the decontamination of equipment and elements of sanitary treatment of the personnel in the temporary sanitary locks on construction sites. NOVARKA shall facilitate the collection of such LRW and their transfer to the existing LRW handling systems following the Employer procedures [4.2.1, 4.3.2]. The volumes of thes LRW and measures on their handling will be determined by the WEPs.

3.6.2.3 Decontamination

In all likelihood, the decontamination system should not interfere with any equivalent system inside the OS or at ChNPP.

Nevertheless, during the Design, NOVARKA will attempt, as far as achievable, to provide for decontamination process and techniques consistent with those procedures and practices currently applicable on-site. This will make easier and more effective the decontamination works inside the NSC and, obviously, prevent the deviation from normal operations that might arise from unusual or insufficiently mastered practices.

3.6.2.4 Personnel sanitary treatment

This system will interface with the OS and ChNPP systems of personnel sanitary treatment. NOVARKA plans to consider in NSC CS-1 Design the interface with Change Facility CF-1430 and located at OS elevation +5.8 sanitary lock. The access of the personnel into NSC CS-1 will be performed via CF-1430. NOVARKA shall retain the access of OS personnel via sanitary lock located at OS Elevation +5.8.

3.6.2.5 Dust suppression system

At the first commissioning stage prior to deconstruction of OS unstable structures and creation of mobile dust suppression system, the dust suppression in Central Hall Unit 4 is expected to be kept operating by means of the existing Modernized DSS at OS.

Further, the existing MDSS cannot be used in NSC as the DSS hoses are partially fixed to the unstable structures and it will be dismantled during deconstruction of these structures.

It is also assumed that the existing plant for the preparation of dust suppression solutions for the MDSS may be used for some period for the same purpose in the future. In accordance with the

plans available, the existing site for DSS solution preparations will not be dismantled. NOVARKA shall facilitate the arrangement of the site for the new mobile dust suppression system (transported by the cranes) and the pipeline from the site to the new mobile DSS, Due to this, the long-term access to the existing site of DSS shall be allowed.

NOVARKA assumes that no explosive, inflammable or toxic solutions will be stored next to the DSS plant for the solution preparation.

3.6.2.6 Water supply and sewage systems

3.6.2.6.1 Potable water supply

The industrial and potable water will be supplied from the existing ChNPP network, considering and assuming that it will have the same life-cycle as the NSC, i.e. 100 years extensible.

The maximum water supply has production rate of 542.08 m^3/day (110.33 m^3/h) [5.3.52]. The approximate location of connection point on the OS site of the ChNPP network is shown in Attachment 3.2.

3.6.2.6.2 Heating supply

The system of heating supply to be developed under NSC CS-1 shall be integrated within the existing OS & ChNPP heat supply. Hot water for NSC CS-1 and CS-2 will be supplied through pipelines T1 and T2 from the ChNPP heat supply system with open water intake.

The parameters of the hot water transfer at the connection points are given in [5.3.52]:

- calculated pressure – 16 kg/cm;
- on-line pressure – 6,3-6,5 kg/cm^2;
- pressure in return pipe – 3,6-3,7 kg/cm^2;
- calculated temperature – 130-70 ^{o}C;
- on-line temperature – 110-70 ^{o}C.

The approximate location of tie-in points of heat supply of CS-1 on OS industrial site to ChNPP net is shown at Figures A3.2-1, A3.2-2 [5.3.46] of Attachment 3.2.

3.6.2.6.3 Domestic sewage system

NSC CS-1 domestic sewage system will collect the domestic discharges from both commissioning stages of NSC. Domestic sewage of NSC CS-1 will be connected to the SPS-1 network of common-household sewage of ChNPP site. Location of the installations of domestic sewage system on the sites where the radioactive contamination of the effluents is possible is not foreseen. The measures to prevent penetration of radioactive contaminants into the domestic sewage system shall be developed, for instance, the collection of water from shower rooms of the sanitary lock and washstands will be divided depending on the location of generation.

The available capacity of the MSPS-1 plant of ChNPP is designed for maximum daily flow rate of 162.14 m^3/day and peak hour flow rate of 100.53 m^3/hour from the NSC [5.3.52].

Arrangement of MSPS-1 (construction №16) is shown in Figure A3.2-1 [5.3.46] in Attachment 3.2.

3.6.2.6.4 Industrial sewage system

System of industrial sewage is intended for water collection incoming from the industrial rooms of NSC, and Technological and Auxiliary Buildings. The water will be collected in precipitation tanks where its purification will take place, mainly from oils. The water discharge from the industrial sewage will be performed into the ChNPP storm handling system establishing the radiological monitoring. The measures to prevent radioactive substances penetration hazard into this network will be foreseen.

3.6.2.6.5 Storm sewage

NSC storm sewage will collect the water accumulated on the NSC during the heaviest rain conditions as defined in the “Design Criteria and Requirements” (see also Section 2.3), including 10% reserve for potential CS-2 extension.

The water export from NSC arch will be organized via the system of secured pipelines to the existing channel running south along the NSC.

The storm water export from NSC site shall be performed to the existing channel located south from NSC with preliminary purification mainly form the mechanical admixtures and potential oil products. The radiation monitoring of the exported waters shall be foreseen.

3.6.3 VENTILATION, GAS PURIFICATION, HEATING AND AIR CONDITIONING

Combined input and exhaust ventilation system aims in particular to prevent condensation formation and creation of required temperature-humidity regime in the main volume of the NSC.

The implementation of the NSC can essentially change the scheme and dynamics of water accumulation, condensation-evaporation in the OS because of the following main causes:

- NSC avoids the ingress of atmospheric precipitation into OS premises;
- NSC construction will cause smoothing of seasonal changes of temperature under it and accordingly in OS premises;
- NSC will cause changes of natural ventilation conditions of OS premises.

Besides, NSC operation will cause formation of operational LRW which quantity, activity, isotope structure and other characteristics should be estimated in Detailed Design on CS-1 NSC and specified at NSC operation. Today there are no unequivocally authentic estimations regarding the ways the water condensates and evaporates, and, accordingly, dynamics of its volumes in OS under NSC.

At the first stage of Detailed Design, it is necessary to analyze the temperature-humidity regime of the NSC in view of thermophysical characteristics of the structures of the NSC heat-insulation arch covering, all thermophysical parameters of the existing OS and technological processes using heated water compounds, and possible accumulations in OS, the amount of water in those accumulations, their locations and configuration.

Upgrade of existing ventilation system of the Deaerator Stack premises shall be foreseen related to air inlet and release considering the independence from atmosphere and ventilation of NSC arch space [5.1.1]. NOVARKA has received from ChNPP the information on the existing ventilation system in the rooms of Deaerator Stack related to air inlet and release, inclusive of the information on input (4-П1 -4-П6) and exhaust (4-В1 – 4-В19) ventilation systems.

The other ventilation systems will not interface with the OS.

3.6.3.1 Integrated monitoring and management system

3.6.3.1.1 Integrated monitoring system

The NSC CS-1 integrated control system will interface with the following OS systems:

- ISDB (SIP Task 18);
- IAMS OS (SIP Task 17) [5.3.54];
- OS Fire Protection System (SIP Task 16).

Reserve shall be provided (on rough estimate 40 m^2) for possible future transferrence and installation of monitoring panel of IAMS OS (room Г-305 Unit 3) in the ICS rooms [5.1.21].

In order to notify NSC personnel about conditions and events at OS and ChNPP that can potentially affect NSC operation, NSC CS-1 ICS will need the following information from external systems [5.1.22]:

- meteorological data on site;
- temperature of air;
- relative humidity;
- atmospheric pressure;
- speed and direction of wind;
- intensity and accumulation of precipitations;
- reference time;
- alarm signals from IAMS in case of radiation accidents;
- signals of fire alarm system.

3.6.3.1.2 Seismic monitoring system

The NSC Seismic Monitoring System will be designed in order to be capable of providing input data via ICS to the ChNPP IAMS. NSC Seismic monitoring system shall consider the OS SSC in particular, OS SSM reference points.

3.6.3.1.3 Radiation monitoring system

During NSC CS-1 Design development, the assessment of interface with SIP Task 17 shall be performed. During NSC CS-1 Design development, the basic decisions will be made related to the system of radiation monitoring for NSC, including construction and operation stages of NSC CS-1. The radiation monitoring system shall be capable for extension for tasks of NSC CS-2.

On the basis of cost-benefit analysis, NSC RMS will as much as possible use equipment of radiation monitoring existing at OS including portable (individual, mobile, etc.) [4.3.9, 4.3.10].

If such is not available at site, NOVARKA will provide additional equipment necessary for CS-1 operations. The decision for the replacement or the use of the existing equipment will be based on cost-benefit analysis.

Nevertheless, because the accident situations will mostly be identified by the RMS, the Design will identify the possible needs for information exchange between the ICS and the OS RMS in order to protect operators from radiation and initiate the potential protection measures such as the closure of ventilation dampers to avoid releases to environment.

3.6.3.1.4 Other ICS systems

The other ICS systems will not interface with the OS Shelter and ChNPP systems.

3.6.4 POWER SUPPLY SYSTEMS

3.6.4.1 Power supply to consumers and systems

The electrical power used by the NSC will be supplied by ChNPP.

ChNPP will provide tie-in points of power supply system 6 kV in new ISB through two independent sources. NOVARKA will ensure connection to these points under the condition that the reliability of power supply is sufficient to facilitate the reliable operation of NSC systems in accordance with their safety classification.

Arrangement of ISB (facility 5) is shown in Figure A3.2-3 of [5.3.47] Attachment 3.2. These tie-in points will be located in Room 8 and four cells (107,109, 207, 209) intended for NSC CS-1 [5.3.52].

3.6.4.2 General, emergency and evacuation lighting

NOVARKA shall facilitate the levels of general, emergency and evacuation lighting meeting the requirements of applied standards and rules.

3.6.4.3 Protective earth/neutral grounding

NOVARKA will design the earthing circuit considering possibility to connect to the existing OS grounding.

3.6.4.4 Lightning protection

NOVARKA will design the lightning protection considering the lightning protection of the existing surrounding buildings at ChNPP.

3.6.5 COMMUNICATION AND ALARM SYSTEM, INDUSTRIAL TV SYSTEM

When creating the NSC CS-1 communication systems, their future development and compatibility with the existing ChNPP systems need to be addressed. [1.10.41].

The Communication and Alarm Systems will consist of telephone, public address, plant information broadcast, emergency notification, synchronized timing, fire alarm, security alarm, and technological alarm and LAN systems [5.3.52].

The telecommunication system at ChNPP site consists of several automated telephone exchanges (ATE) connected to common use telephone system and connections between them, for example, ChNPP ATE, OS ATE, ATE at Small Stroybaza. Industrial NSC ATE will be engaged into general telecommunication network of ChNPP as terminal station. Contact of NSC subscribers in the common use communication network is carried out through ATE of ChNPP communication centre in the building "Quantum".

Connection points are located in room 106 ОАК of the Small Stroybaza, Figure A3.2-4 [5.3.48] of Attachment 3.2 to this document.

During Detailed Design, possibilities of interfacing the Industrial CCTV of NSC and other ChNPP Industrial CCTV networks will be explored.

3.6.6 FIRE SAFETY SYSTEMS

Explosion-fire and Fire hazard classification of premises and buildings will be defined in accordance with NAPB B.03.002-227 (replacing normative document ONTP 12-86). The NSC buildings (Technological building, Southern & Northern airlocks) will be ranked as Category 1 according to this norm.

NCS designed fire protection systems will be integrated, whenever possible, into the existing fire protection systems of the OS and ChNPP site if the existing systems comply with the required technical level [5.1.21].

Reconstruction of OS and ChNPP site fire protection systems is not a part of works regarding NSC CS-1.

NOVARKA's scope of works does not foresee any improvement or change of the existing or future ChNPP site or OS fire protection systems, except connections with Dewatering system and Fire fighting water supply.

In case of fire, the ChNPP and OS fire brigades will be informed by:

- Fire notification and evacuation management system,
- Automatic fire alarm system.

NOVARKA will envisage during the Design stage technical measures to prevent spreading of fire and combustion products from NSC to Unit 3 and OS.

3.6.6.1 Automatic fire extinguishing system

The creation of installations of automated fire extinguishing aims at automated fire extinguishing by means of fire-extinguishing substance release.

Interface with OS fire system shall be ensured.

3.6.6.2 Automated fire alarm system

Installations of automated fire alarm system are intended for detection of the fire, processing and provision of notice of the fire at the monitored facility, special information and release of commands for initialization of the installations of fire automatics and other technical means.

Fire alarm will be transmitted to the Main fire control panel (located in the Main Control Room inside the Technological building), then from this panel to OS fire protection system. The connection with the OS automated fire alarm system shall be ensured in order to provide information on fire occurrence in OS. The notice on fire shall be duplicated at communication post located in SSE ChNPP Fire Brigade facility.

Communication networks, quantity and location of these remote elements will be described during the Design stage in accordance with requirements of applied standards.

3.6.6.3 Fire water supply system

Integration with OS and ChNPP site existing Fire water supply systems will be provided but NSC Fire fighting water system will be organized as an independent system (fire water tanks and booster-pumps located in the Technical area).

The source of fire water supply is the ChNPP industrial water supply system with water from the Cooling pond (Approximate coordinates of tie-in point X=430360,00 - Y=51409,700).

Fire water supply system shall be described during the Design stage in accordance with Ukrainian normative documents and ChNPP requirements.

Water supply for fire fighting water purposes in NSC (CS-1 & CS-2) comes from the following simultaneous loads:

- 10.0 l/sec (two streams of 5.0 l/sec) to extinguish inner fire (cabinets with hoses inside the building)
- 15.0 l/sec to extinguish external fires (fire hydrants)
- 28 l/sec for automated extinguishing devices (sprinkler systems).

Approximate 6.7 kg/cm^2 pressure will be kept in the system in such circumstances.

The approximate location of tie-in points on OS industrial site to ChNPP network is shown in Figures A3.2-1, A3.2-2 [5.3.46] of Attachment 3.2.

3.6.6.4 Fire and Evacuation Management Notification systems

The Fire and evacuation management Notification systems are:

- Fire announcement system;
- Evacuation management system;
- Fire brigades announcement system.

The notification of the personnel in case of fire shall be implemented by one of the following ways:

- production of sound and/or light signals to all rooms of facility with permanent or periodical attendance;
- transmission of language notices on necessity to evacuate, the ways of evacuation and other actions directed to people safety facilitation.

Personnel evacuation management shall be implemented by:

- switching-in of the evacuation lighting and light pointers of evacuation direction;
- broadcasting of specially developed texts in the fire notification system, intended to prevention of panic and other events complicating the evacuation process (crowding in passage-ways, etc.);
- broadcasting of messages containing the information on necessary movement direction.

Systems of notifications shall be implemented considering the direct broadcasting from the working place of Facility Shift Manager of a message and guiding commands via microphone for operative response under change of situation or breaking of ordinary conditions of evacuation, and also possibility to speak with the personnel staying in attended rooms.
System of fire notification and evacuation management will interact with the similar OS systems in order to facilitate the evacuation of the personnel staying inside OS.

3.6.6.5 Smoke protection system

The samoke protection system aims at facilitation of safe evacuation of the personnel at the initial stage of the fire on the account of prevention of smoke impact on the people, increased temperature and toxic combustion products. When designing NSC CS-1 the possibility of fire origin inside OS with release of combustion products into the main NSC volume shall be considered among the other. The OS existing, designed and created systems of smoke protection shall be considered.

3.6.7 PHYSICAL PROTECTION SYSTEM AND ACCESS CONTROL

The Physical Protection System and Access Control system is out of CS-1 scope [1.10.41]. CS-1 shall reserve spare room of 70m² at the entrance of the NSC Technological facility for future installation (by others) of access control and physical protection equipments (turnstiles, card readers, etc.).

NOVARKA shall equip with the sensors and locks the doors ono the access ways to the sites, areas and equipment, the access to which shall be restricted. The signals produced by these sensors shall come to the OS/ChNPP Access Control and Physical Protection System, the development and installation of which are performed by other contractors.

3.7 INTERFACES BETWEEN NSC CS-1 SYSTEMS WITH CS-2 SYSTEMS

The Strategy of NSC implementation [5.1.3] stipulates that CS-1 detailed design takes into account NSC life-support and monitoring systems so that these systems can perform necessary functions, directly related to deconstruction under CS-2.

The upgrade of the confinement auxiliary systems for CS-2 deconstruction activities is excluded from CS-1 scope of works.

This section does not provide summary of the main requirements defined in document “Clarification on NSC Systems”. It does not provide statements which come in contradiction with this document.

All these systems shall be designed so that in order for them to perform functions directly referring to deconstruction of unstable structures it would be as a rule enough to install in addition (from places of connection to deconstruction sites) measurement and management channels, cable lines, communications, additional equipment in places related to deconstruction.

Therefore, communications of CS-1 with CS-2 and technology of structures deconstruction will be considered during CS-1 NSC designing.

NOVARKA will propose during the Detailed Design reservations, locations and places of connection points, power supply for upgrading of auxiliary systems of confinement for CS-2 deconstruction activities in accordance with information available to NOVARKA to date. The CS-2 Contractor will have to meet the requirements set by NOVARKA Detailed Design. In case CS-2 activities require different provisions, ChNPP / SIP-PMU shall coordinate both Design activities and make the decision whether it shall instruct NOVARKA of changes in its scope of work.

The general interfaces between systems and facilities to be considered in NSC CS-1 Design with regards to the technologies of CS-2 scope are provided below. The description of these interfaces between NSC CS-1 and CS-2 cannot be exhaustive at this stage, since during design and coordination with CS-2 contractor, additional requirements could be established and new information become available.

At initial stage NOVARKA shall develop technical specifications, which will establish basic initial requirements and data for deconstruction design and make proper reserve of systems capacity for deconstruction purposes. ChNPP / PMU are in charge of coordinating schedules for CS-1 and CS-2 and shall develop procedure for interface between NOVARKA and CS-2 Contractor at an early stage of the design development; it will specify scope of responsibilities for each contractor in order to address the other party needs.

3.7.1 NSC BUILDINGS

3.7.1.1 Main NSC Facilities

The NSC internal configuration (premises, zones, sites, working areas, utilities networks, transport roads, access routes, evacuation routes, emergency exits, etc.) shall be designed, taking into account additional structures necessary for CS-2 as described in documents [5.1.3, 5.1.9, 5.1.21] and include the following facilities:

1) sites and facilities necessary for placement (including storage) of equipment intended for deconstruction purposes, and tie-in locations for systems of life-support and state monitoring;

2) site and facilities for preliminary processing of dismantled structures including:
    - walls and roof of the facility with opening for acceptance of dismantled structures equipped with biological protection;
    - reserve for installation of railways for 15t trolleys;
    - reserve for installation of railways for semi-gantry crane (20t) from the way installed on site of trucks' loading;
    - local strengthening of coating in loading area and under technical maintenance garage for main crane quadrilaterals;
    - tie-in locations for system of NSC life-support and state monitoring;
3) site and facilities for preparation of dismantled structures including:
    - reserve for installation of railways for 15t trolleys;
    - reserve for installation of railways for semi-gantry crane (20t) from the way installed within the entire territory from the ways on site of trucks' loading;
    - walls and roof of the facility;
    - tie-in locations for system of life-support and state monitoring;
4) temporary laydown area; southern gates and airlock for passage of large-scale trucks, including:
    - arrangement of temporary laydown area, including its equipment with all the necessary systems of life-support and state monitoring;
    - southern sliding gates of the western end wall with control panel;
    - airlock for passage of materials and equipment equipped with all the necessary systems of life-support and state monitoring;;
    - creation of the necessary conditions for further expansion of systems including but not limited to, decontamination, LRW collection, mobile shielding, local ventilation;
5) truck loading site, northern gates and airlock for standard trucks, including:
    - access gates for the standard vehicles;
    - post of outgoing radiation control of wastes and vehicles;
    - crane (20t) with control system and railways to beginning of the preliminary processing site;
    - other systems of life-support and state monitoring;
6) territory for the temporary storing of packed RAW site including reserve of the area for buffer containers storage based on the information provided by NSC-CD.
7) Dust suppression solution preparation area. It is assumed that the existing plant for the preparation of dust suppression solutions for the MDSS may be used for some period for the same purpose in the future. In accordance with the plans available, the existing site for DSS solution preparations will not be dismantled. NOVARKA shall facilitate the arrangement of the site for the new mobile dust suppression system (transported by the cranes) and the pipeline from the site to the new mobile DSS, Due to this, the long-term access to the existing site of DSS shall be allowed.
8) System of Access routes, evacuation routes, emergency exits, etc.

9) Solid insulating coating of open parts of soil inside NSC.
10) Facility for stationary sanitary locks at the boundaries and inside NSC for both commissioning stages.

3.7.1.2 Auxiliary buildings and constructions, interfaces

The CS-1 scope includes:

- Buildings and constructions for accommodation and operation of NSC life-support systems (sewege pump station, building for fire extinguishing system, technological area, arrangement for the new mobile dust suppression system, etc.);
- NSC external engineering communications;
- Buildings and constructions of infrastructure on NSC site;
- Covering and arrangement of the NSC area

and other constructions will be designed to accommodate CS-2 structures deconstruction needs and related interfaces. The solution preparation plant of the existing DSS will be kept in the NSC for the new mobile DSS.

For creation of the necessary rooms, the reserve of rooms considering CS-2 is required but not limited to:

ROOMS	NECESSITY TO RESERVE AREA	NECESSITY TO RESERVE CONSIDERING CS-2
Sanitary locks	+	-
Ventilation room of Auxiliary building	+	-
Arch input ventilation room (if required to place in this building)	+	-
Rooms for electric panel and control panel location	+	+
Control room	+	+
Shop of technical maintenance, decontamination and repair of equipment	+	+
Radiation safety shop	+	+
Offices	+	
Entrance to Auxiliary building	-	-
Hall ways	+	+
Locks, shower rooms and relaxation rooms	+	-
Room of clean mechanical equipment	+	-

Establishment of local systems facilitating the maintenance of certain temperature and moisture regime in the rooms of permanent technology process and/or personnel attendance, and also in working zones is envisaged in NSC. NSC CS-2 Contractor is responsible for provision of the equipment to facilitate the conditions at the open areas under NSC arch where the direct works on handling of dismantled structures are implemented, and transfer of parameters for development of design of NSC internal arrangement.

3.7.2 MAIN CRANE AND INDOOR TRANSPORTATION SYSTEM

NSC CS-1 cranes and transport design scope will include:

- Deconstruction scenarios as described in document [5.1.9] and in document "Deconstruction of Main Beams" Ref. DD-303 from the NSC CD (FS);
- Deconstruction tools foreseen for CS-2. The current reference document used is the list from document "Dismantled Element Process Equipment and Related Radioactive Waste (RAW) Management", Ref DD-306 from the NSC CD (FS).

The following shall be implemented in NSC CS-1:

- to facilitate the system of main cranes including the control and management systems, systems of power supply, garages for technical maintenance, rooms for storage of crane quadrilaterals, devices for fastening of suspended equipment, etc, special trolley with telescopic mast;
- to facilitate the equipment for transportation and loading of operational RAW of CS-1;
- to facilitate the equipment for transportation of personnel and freights for CS-1;

The equipment for transportation of personnel involved into deconstruction activity, and materials, equipment and wastes generated or used during deconstruction, is not included into the scope of CS-1 contractor. However, the Contractor shall provide the internal system of transportation, meeting the requirements of CS-1 needs excluding the negative impact on NSC CS-2.

The general requirements for functional purpose of this system designed under NSC CS-1 considering CS-2 are presented in Section 1.4 of CDSD.

3.7.2.1 Sites and equipment for remote deconstruction of unstable structures

Sites and constructions necessary for accommodation of equipment, including, its storage, system of main cranes, places of connection of life-support systems and monitoring of CS-1 status, will be designed meeting the following requirements: motorized, including remote operated equipment for deconstruction that will provide fragmentation of structures, their moving to sites of temporary stockpiling and preliminary processing, decontamination and dust suppression (fixation), collecting of RAW in places of deconstruction and their transportation, etc.; other equipment necessary for deconstruction; additional structures for deconstruction, expansion of NSC life-support and status monitoring systems.

The general requirements related to the composition of this site and equipment designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.2.2 Site and equipment of preliminary processing

The preliminary processing area of the NSC will be designed considering the processes of structures deconstruction developed by ChNPP during its Conceptual Design.

The following equipment intended for management with deconstructed structures and accomplishes RAW shall be taken into account:

- Trolleys (15 tons);
- Crane (20 tons);
- Forklift.

Other equipment such as equipment for fragmentation of structures, dust suppression equipment will be provided by the CS-2 Contractor. Compliance of this equipment with the NSC criteria will be checked during its Design.

Preliminary processing area of the NSC shall be designed addressing deconstruction technologies developed by the ChNPP in the Conceptual Design (DD 303 and Strategy).

When designing the area it is also necessary to consider possible expansion of NSC life-support systems and status monitoring, maintenance of technological processes of primary processing, additional structures for management with deconstructed structures and associated RAW.

The general requirements related to the composition of this site and equipment designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.2.3 Preparation Area

The preparation site in the NSC will be designed considering the process of structures deconstruction developed within NSC CS-2. Depending on provided by CS-2 technologies the following shall be considered:

- Necessity to create the additional zones for decontamination and fixation of surface contamination taking into account the acceptance criteria:
- Requirements to special sewage system;
- Conditions for ventilation system.

The general requirements related to the composition of this site and equipment designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.2.4 Site of temporary laydown area and southern airlock for passage of large-scale vehicles

The design of NSC CS-1 shall define buffer storage area of containers based on the information from the Conceptual Design and on the available space inside the NSC considering the movement routes available. The site shall facilitate the necessary space for further placement and utilization of the equipment intended for technologies of FCM removal and accompanying RAW.

The temporary laydown area shall be designed considering the data on OS contaminated dismantled structures and accompanying RAW, types of containers used for transportation, their loading (type and dimensions of vehicles used for transportation) for transfer to ChNPP RAW handling infrastructure.

Southern sliding gates with the airlock shall facilitate the passage of large scale vehicles with materials and equipment considering the potential accidents and establishment of radiation monitoring.

The general requirements related to the composition of this site and equipment designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.3 PROCESS SYSTEMS

3.7.3.1 SRAW handling system

SRAW handling system shall be designed considering the additional equipment for collecting, preliminary sorting, containerisation and loading of SRAW to be produced during the

dismantling of unstable structures. These will be located in the preliminary processing building, the size of which is not planned for modifications considering the CS-2 needs.

\When designing the CS-1 SRW handling system the interfaces with transportation and technological scheme of deconstruction shall be considered including the following:

- Initial data related to parameters of dismantled structures (geometric dimensions, value of surface contamination density, weight, dose situation and possibilities of its modification for establishment of preliminary monitoring of radiation parameters of dismantled structures;
- Types and sizes of containers for establishment of radiation monitoring of RAW moved to temporary laydown area and/or technological building;
- SRW certification considering the removed dismantled structures;
- Criteria of acceptance of SRW to the facilities of RAW handling;
- Consideration of features of all systems involved for handling sites of dismantled structures in order to provide the radiation zoning of rooms used for deconstruction, etc.
- Upon obtaining of initial information on deconstruction technologies and transportation and technological scheme from CS-2 the requirements for components of CS-1 SRW handling will be specified.
- The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.3.2 LRAW management system

NSC CS-1 shall facilitate all the necessary equipment and arrangement of appropriate rooms and sites, stationary locations for effluents collection considering the needs of NSC CS-2, and tie-in points for system of mobile means of collection for NSC CS-2.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.3.3 Decontamination system

The CS-1 decontamination system (shop for equipment and tools decontamination) shall be designed to include (though partially) CS-2 needs limited to the working area of the NSC and consider:

- Equipment for decontamination of CS-1 needs and partially CS-2 and arrangement of the appropriate rooms and sites. Shop for equipment and tools decontamination shall consider the need in decontamination of portable equipment (devices, claws, rigging, tools, etc.) to be used during deconstruction. The same refers to decontamination of crane system and components, loading-unloading and other mechanisms, containers, process and other equipment, transportation means (in particular, at exit from NSC), and PPE and collective protective means. CS-1 scope does not include the equipment for decontamination of the dismantled structures themselves, basic equipment (specific for deconstruction) to be decontaminated directly in the locations of deconstruction, collection of accompanying RAW, sites of preliminary processing and preparation of dismantled structures and RAW for transportation to the other ChNPP facilities. Also, special plant for loading and transportation of dismantled structures and RAW is not included. The CS-1 decontamination system shall consider the needs for decontamination of rooms, sites, access ways, etc. and if possible take into account the needs of decontamination of sites on dismantled structures handling (preliminary processing, preparation for temporary storage, and loading);

- Provision of decontamination system for CS_1;
- Tie-in points for CS-2;
- Stationary sanitary locks at the NSC boundaries, in Technological building, inside NSC, for both commissioning stages.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.4 POWER SUPPLY SYSTEM

The power supply system of CS-1 shall be designed to ensure uninterruptible functioning of all equipment. This system shall facilitate the following:

- supply of power to all NSC systems important to safety under any option of operation;
- implementation of required functions under the design events (maximum design earthquake, tornado, etc.), and in the result of any thermal, mechanical, chemical and radiation impacts occurring due to the accident at NSC;
- facilitation of necessary duration of work under loss of main power supply;
- facilitation of redundancy of power supply systems;
- emergency and evacuation lighting.

NSC CS-1 shall provide the power supply system for CS-1 and consider the needs of NSC CS-2, including the following:

- all necessary equipment considering the needs of both commissioning stages and arrangement of appropriate rooms and sites;
- power supply to consumers of CS-1;
- lighting to consumers of CS-1, emergency and evacuation lighting;
- tie-in points for consumers of CS-2;
- system of protective grounding;
- lightning protection system;
- integration with OS and ChNPP systems. Integration means the exchange of information on system status between the control panel of NSC and OS & ChNPP systems, where necessary.

It is necessary to facilitate in NSC CS-1 the power saving and equipment for operation and maintenance of the arch and accompanying auxiliary facilities. Besides, at the stage of detailed design of NSC CS-1, the interface with NSC CS_2 contractor shall be ensured in order to facilitate the reserve capacities sufficient for NSC CS-2. The reserve in particular shall envisage the reserve for sizes, capacities and arrangement of electric panels, placement of Main Control Board, chains, cable boxes, lighting, etc. considering the planned loads for CS-2. Power supply and cables shall be designed to comply the initial operational requirements, and future loads of CS-2. Detailed design shall quantitatively define the requirement for redundancy. 50% reserve may be envisaged to be specified further. Reserve electrical loads shall be foreseen in the detailed design, including feeders, channels, cables, switchers and other equipment in sufficient amount and possessing the features (considering the future safety classification) in order to stand the loads for both commissioning stages. Also, the chains and electrical panels connected to the loads of NSC CS-2 shall be assembled. Table below presents the rooms of 1-3 zones for which the following shall be envisaged:

ROOMS, SITES	POWER SUPPLY TO EQUIPMENT OF NSC CS-1 AND CS-2
Zone 1	
Rooms of ventilation for Auxiliary building	Technology equipment of ventilation systems, lighting, radiation monitoring equipment, emergency and evacuation lighting, fire protective equipment
Rooms of exhaust ventilation of Arch	Technology equipment of ventilation systems radiation monitoring equipment, emergency and evacuation lighting, fire protective equipment
Storage site	Lighting, technology equipment, TV, power unit, local lighting, local ventilation, motorized door radiation monitoring equipment, emergency and evacuation lighting, fire protective equipment
Preliminary processing site	Lighting, technology equipment, TV, local lighting, equipment of special sewage local ventilation, motorized doors, radiation monitoring equipment, emergency and evacuation lighting, fire protective equipment
Preparation site	Technology equipment, lighting, equipment of special sewage, motorized doors, radiation monitoring equipment, emergency and evacuation lighting, fire protective equipment,
Platform (garage) for crane maintenance in NSC arch	Basic crane equipment, lighting, electrical heating, access elevator, emergency and evacuation lighting, operator station, fire protection equipment, Radiation monitoring equipment
Zone 2	
Hot sanitary locks	Lighting, local equipment of electrical heating, ventilation, conditioning (if necessary), equipment of special sewage, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Shops of technical maintenance and equipment repair	Lighting, technology equipment, power units, local ventilation, motorized doors, charging devices, radiators, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Movable dust suppression site	Technology equipment, lighting, electrical heating, radiation monitoring equipment, fire protection equipment
Shop for equipment and tools decontamination	\\lighting, technology equipment, special seqage system, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Entrances into the building inside NSC and hall ways	Lighting, emergency ventilation, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Routes of personnel movement inside NSC, in	radiation monitoring equipment, fire protection equipment

ROOMS, SITES	POWER SUPPLY TO EQUIPMENT OF NSC CS-1 AND CS-2
particular, access to OS and DS walls	
Site for storing of crane equipment and deconstruction equipment	radiation monitoring equipment, fire protection equipment
Sites for vehicles loading	Technology equipment, general lighting, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Existing DSS site	radiation monitoring equipment, fire protection equipment
Sites for control of entrance/exit via northern and southern gates	radiation monitoring equipment, fire protection equipment
Zone 3	
«Cold» sanitary locks	Lighting, air conditioning (if necessary), radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Rooms of electrical board and control panel	Lighting, local ventilation, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Radiation safety shop	Lighting, technology equipment, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Office rooms	Lighting, local ventilation, conditioning, office appliances, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Entrances of Auxiliary building from outside NSC, hall ways	Lighting, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Locks, relaxation rooms and shower rooms	Lighting, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Rooms of clean mechanical equipment	Lighting, equipment of industrial and domestic sewage, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Rooms of input ventilation of sub-arch and annular space	Ventilation equipment, lighting, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment
Orifices for access of vehicles from outside NSC	Lighting, radiation monitoring equipment, fire protection equipment
Control rooms	Lighting, ventilation, conditioning, equipment of upper level of NSC management and control systems, radiation monitoring equipment, emergency and evacuation lighting, fire protection equipment

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.5 COMMUNICATION SYSTEM, ALARM SYSTEMS AND WARNING, INDUSTRIAL TV

In NSC CS-1, the system of communication, alarm and warning for NSC CS-1 shall be facilitated considering the needs of NSC CS-2, including:

- All necessary equipment considering the needs of both commissioning stages and arrangement of appropriate rooms and sites;
- Facilitation of communication, alarm and warning for CS-1;
- Tie-in points for CS-2;
- Integration with OS and ChNPP existing systems.

In NSC CS-1, the system of industrial TV for NSC CS-1 shall be facilitated considering the needs of NSC CS-2, including:

- All necessary equipment considering the needs of both commissioning stages and arrangement of appropriate rooms and sites;
- Provision with industrial TV for CS-1 if necessary for operation of CS-1;
- Tie-in points for CS-2;
- Integration with OS and ChNPP existing systems. Integration means the exchange of information on system status between the control panel of NSC and OS & ChNPP systems, where necessary.

- The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.6 VENTILATION, GAS PURIFICATION AND AIR-CONDITIONING SYSTEMS

In NSC CS-1, the system of ventilation, gas purification and conditioning for NSC CS-1 shall be facilitated considering the needs of NSC CS-2, including:

- System of input-exhaust ventilation of the arch space in order to prevent the creation of condensate and, if necessary, creation of required temperature and humidity regime with establishment of radiation monitoring of releases;
- System of ventilation in order to prevent the distribution of contamination when opening the northern gates and southern airlock;
- Input-exhaust ventilation of arch space and conditioners for heating of input air;
- System of ventilation of Auxiliary (Technological) Building, including input and exhaust ventilation of rooms of 1 and 2 zones (air locks, shops of technical maintenance, decontamination and repair, sanitary locks, etc.), central control panel; office rooms, shower rooms, other rooms and sites (considering the needs of both commissioning stages);
- Modification of existing ventilation system of DS rooms in part of airlet and release in order to avoid the combining of atmosphere and ventilation of arch space of NSC;
- System of ventilation of facilities of NSC internal arrangement for CS-1, reserve for areas and connection points for CS-2;
- Ventilation systems for other auxiliary buildings and facilities of CS-1, reserve for areas and connection points for CS-2;

- Facilitation of gas purification in ventilation systems of CS-1 meeting the requirements of sanitary standards, reserve for areas and connection points for CS-2;
- Facilitation of air conditioning in ventilation systems of CS-1 meeting the requirements of sanitary standards, reserve for areas and connection points for CS-2.

Besides the above, per OSPU (It. 12.2.23, 12.2.24) for the works of I class in rooms of 1 and 2 zones it is necessary to envisage the system of air supply with concentration of radionuclides not exceeding the permissible one to the hose PPE (pneumatic suits, pneumatic helmets, hose gas-masks), which shall have the air-distributing devices for simultaneous switching of at least 2 hose PPE .

Violation of this requirement shall be justified considering the cost-benefit analysis. NSC CS-1 shall consider but not install the equipment of this system. The NSC CS-1 design shall contain limitations (for instance, physical space and capacity of power network) a;llowing the CS-2 Contractor installing this equipment.

Ventilation systems of NSC internal arrangement facilities for the sites of portables and existing DSS, access routes, sites of storage of crane equipment and equipment for deconstruction, vehicle loading sites. Ventilation systems on these sites shall be required only if any of them will be isolated from the basic NSC sub-arch space. Equipment for implementation of works connected directly with dismantling of unstable structures and with handling of them is included into the scope of work of CS-2 contractor. NSC CS-1 Contractor shall consider in the appropriate design the possibilities of installation of additional equipment. The basic function of these systems is the maintenance of controlled ambient medium for the work of the personnel and operation of the equipment. It is supposed, that the above mentioned sites refer to 2 zone.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.7 WATER SUPPLY AND SEWAGE SYSTEMS

3.7.7.1 Drinking and industrial water supply system

The NSC CS-1 Design shall provide combined industrial and drinking water system for NSC CS-1 considering NSC CS-2 needs:

- All the equipment necessary considering the needs of both commissioning and arrangement of appropriate rooms and sites;
- System of combined industrial and drinking water supply for NSC CS-1;
- Tie-in points for NSC CS-2.

The discharge of domestic effluents beyond the limits of NSC shall be performed to the pump station and further to the network of domestic sewage of ChNPP site.

The measures to prevent the penetration of radioactive substances into the domestic sewage shall be undertaken. In lavatories of the restricted zone the advisability of biotoilets shall be considered. The system shall not serve the zones with potential radiation contamination.

In NSC CS-1, the system of industrial and domestic sewage for NSC CS-1 shall be facilitated considering the needs of NSC CS-2, including:

- All the equipment necessary considering the needs of both commissioning and arrangement of appropriate rooms and sites;
- Facilitation of sanitary and domestic sewage for both commissioning stages;

- Tie-in points to the system of collection of effluents for CS-2 (if impossible to fully implement item above).

The system shall be connected to ChNPP site system.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

The design will take into account maximum shift of 120 persons, including CS-1 and CS-2.

The following initial conditions are accepted for determination of the NSC personnel number:

- NSC is not an independent facility, it is a part of SSE ChNPP;
- NSC operation shop is a structural division of SSE ChNPP;
- Organizational structure of SSE ChNPP contains all the necessary for operation of NSC structural divisions allowing not to create similar structures in NSC>
- Repair of equipment and systems will be performed within ChNPP;
- Works on deconstruction of unstable structures are the technology operations requiring the special skills and training, i.e. personnel of ChNPP involved into these operations refer to the operative personnel of NSC.

Based on the assumptions accepted, the following is envisaged for NSC:

- Permanent stay of the maintenance of personnel during work execution at sites for:
- radiation monitoring;
- central control panel;
- local panels;
- office rooms;
- sites of secondary fragmentation and packaging;
- periodical stay of personnel in rooms of:
- distribution site;
- primary fragmentation;’
- decontamination site;
- in design locations of dismantled structures;
- sites of RAW containers temporary storage;
- workshops.

The number of personnel in the maximum working shift for the period of deconstruction of unstable structures is 120 persons without personnel periodically staying in the protective box. The expected number of personnel during the period prior to deconstruction is approximately 60 persons in maximum working shift. These numbers include the personnel of sanitary locks and personnel performing radiation monitoring at the exit of NSC.

For maintenance of electrical systems and I&C systems the involvement of personnel of the appropriate shops of OS is possible. Thus, these staff positions may be exluded from the NSC personnel.

Upon specification of the composition of Technological building at the stage of detailed design it is necessary to precise the necessary number of personnel.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.7.2 Fire water system

The capacity of the fire water supply system without consideration of needs of NSC Arch structures cooling shall constitute 380l/min (100 gallons per minute) per each hose and at least 6.9kg/cm^2 in the highest two points of location of the hoses, any stand pipe, simultaneously with operation of the largest spraying system which may be fed from the same stand pipe (combined stand pipe).

The water shall be directed to various sites of NSC from the main fire chain entirely surrounding the NSC facilities. In accordance with NCS-CD the main fire chain consist of 30cm (12 inch) heat-insulated pipeline in the concrete case. This concrete case is surface along the perimeter around NSC. The control and isolation of the main fire chain shall be provided per section. Hydrants shall be located along the fire chain. Each hydrant shall be equipped with gate valve, opened with a key. The trolley for the hose shall be located in vicinity of hydrant. Each trolley may be delivered manually to each of hydrants. The access to the pipeline shall be arranged for the purposes of repair and technical maintenance.

The pipeline is surface, part of it is located inside the facility in order to remove the obstacles for the passage for transportation and personnel, and foundations. The measures to prevent freezing are required.

The pipeline is looped in two locations: from the north and south of the NSC Auxiliary building. All the sites of NSC are within the attainability of at least one of the effective hose flow. The locations of hoses are outside of entrances to the contaminated areas and beyond the entrances to the main NSC control room. In accordance with the applied norms and standards all hose reels are equipped with fog-forming nozzles and direct spraying nozzles.

The fire sprayers shall be provided in the rooms and on sites in particular of Auxiliary building meeting the above requirements, in particular data on fire load. Types of sprayers, density of spraying and size of each protected site shall be defined in Detailed Design. The water shall be delivered to various sites protected by the sprayer system. The external valves controlling each system of automated spraying, possess the control switches producing the signals of malfunctions in this system to the panel of fire protection in the NSC control room. Maximum expected flow in the system considers the flow of the largest sprayer plus release from one fire hose. On sites where there are no sprayers the use of two fire hoses is envisaged. The required flow and designed time for fire extinguishing shall be defined in Detailed design.

The water collection sprayed on the NSC sites shall be performed with the help of drainage system of the facility. The type of compound for fire extinguishing shall be selected based on the requirements and conditions of nuclear, radiation and fire safety in NSC rooms, and peculiarities of the protected equipment. The systems and components of fire extinguishing shall be installed in all the rooms and sites created in CS-1 including those reserved for CS-2.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.7.3 Heating system

The heating system design shall consider the following functions of the system:

- Facilitation of normal conditions for personnel work;
- Possibility to maintain the necessary temperature in individual technological NSC rooms within the limits of technological and design parameters;

- Heating supply of mixing chambers for preparation of hot water for technological needs and hot water supply.

At the further stages of design these decisions shall be specified meeting the requirements of Ukrainian normative documents.

In NSC CS-1, the heating system for NSC CS-1 shall be facilitated considering the needs of NSC CS-2, including:

- All the equipment necessary considering the needs of both commissioning and arrangement of appropriate rooms and sites;
- Provision of the heat supply for NSC CS-1;
- Tie-in points for heating system of CS-2;
- Integration with the ChNPP existing systems.

The water for heating shall come from the ChNPP site heating network. The water may be directed to HVAC equipment or for heating of the secondary closed contour. The design shall envisage the measures to prevent the freezing of coils subject to cold air impact. It is recommended to consider the possibility of installation of engine-driven valves and manipulators for flow control. Selecting the pneumatic valves andmanipulators the source of compressed air supply shall be foreseen.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.7.4 Industrial sewage system

In NSC CS-1, the system of industrial sewage for NSC CS-1 shall be facilitated considering the needs of NSC CS-2, including:

- All the equipment necessary considering the needs of both commissioning and arrangement of appropriate rooms and sites;
- Provision of industrial sewage of CS-1 and stationary places for collection of floor waters for CS-2;
- Tie-in points of mobile (if necessary stationary) plant for collection of effluents for CS-2.

The system shall be connected to ChNPP site system.

The discharge of the industrial sewage system shall be performed to the system of industrial sewage of ChNPP or storm water processing system. Predominantly, the purification of precipitations from oils is required. The latching – outgoing radiation monitoring is required. The measures to prevent the radioactive substances penetration shall be foreseen (for instance the system shall not be installed on the sites where the radioactive contamination is possible).

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.7.5 Storm water sewage system

Storm water sewage system shall be designed for NSC needs, adding provision of 10 % for possible future CS-2 needs (in case additional facilities would be built). Possible tie-in points for CS-2 needs will be limited to natural discharge inside the open sewage trench of the NSC.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.7.6 Personnel sanitary processing system

The system of personnel sanitary processing is foreseen as stationary sanitary lock in the Technological building and mobile sanitary locks which can be installed in any location of NSC main facility and Technological building for implementation of special works.

The mobile sanitary locks shall be installed in the working areas for the works requiring additional localization and control of personnel access, for instance, reduction of sizes of dismantled structures within CS-2 or decontamination of CS-1 equipment. These sanitary locks will be portable, easily installed / dismantled structures and tents (for example film tent), equipped with portable fans in order to provide the safe air movement from the zones with lower contamination level to the zones with higher contamination level.

The capacity of the sanitary locks shall be designed considering the CS-2 needs.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.7.7 Dust suppression system (DSS)

In order to avoid interferences with CS-1 project, the existing DSS preparation plant will not be rebuilt at some other place. The existing site will therefore be covered by the NSC.

The DSS preparation plant is required until OS dismantling, and will be used afterwards for the preparation of solutions for the CS-2 new mobile DSS.

Access for personnel and for small trucks, delivering chemicals, to the existing dust suppression preparation plant has to be considered in the layout of the NSC.

The design, procurement and installation of the new mobile DSS for deconstruction activities are not included in the NOVARKA's scope of work.

The CS-1 Design will provide the ducts and tie-in from the DSS preparation plant to the new area receiving the future CS-2 new mobile DSS (see Section 18 of [5.1.1]).

Document [5.1.21] states that the DSS should be considered as a subsystem of the ICS, but the existing DSS is running with no means of communication.

No specifications have been given for communication between existing DSS and ICS. At the first stage, NOVARKA assumes that the DSS will continue to run like it does today.

Access to the DSS preparation plant will be assured during the NSC Construction.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.7.8 Special sewage system

The design of LRW processing system shall be developed including collection for further removal from NSC to ChNPP system. Installations on LRW management shall facilitate the collection of primary and secondary LRW and transfer of them to ChNPP LRW handling system.

The NSC design scope of work does not include the development of technological decisions related to LRW purification from TUE. In NSC CS-1, the system of special sewage for NSC CS-1 shall be facilitated considering the needs of NSC CS-2, including:

- All the equipment necessary considering the needs of both commissioning and arrangement of appropriate rooms and sites;
- Provision of LRW collection system(special sewage) and portable equipment of CS-1 and stationary places for collection of LRW for CS-2;

- Tie-in points of mobile (if necessary stationary) plant for collection of LRW for CS-2.

The system shall be connected to ChNPP site system.

The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

Considering the water supply reserve for Contractor of NSC CS-2 in NSC CS-1 the water reserve shall be facilitated by way of provision of captive pipelines, valves and tie-in points, necessary for the Contractor of NSC CS-2 for extension of capacity aiming at deconstruction works performance in the rooms and on sites where these are to be implemented.

The table below provides the summary list of needs of sewage of various types of NSC CS-1 considering the reserve for NSC CS-2. Besides usual water height from the technological equipment and other different sources, for instance, such as floor washing, the systems shall be designed for the maximum flow from the fire systems. The systems shall be designed for the maximum flow from the fire systems of one site for the period of 90 minutes. Besides, the precipitation tank is required together with oil catcher, pump of precipitation tank and pool for water from the fire system.

ROOMS, SITES	WATER SUPPLY			SEWAGE	
	DOMESTIC AND DRINKING	HOT	FIRE	SPECIAL SEWAGE	INDUSTRIAL SEWAGE
Zone 1					
Room of ventilation for auxiliary building	-	-	+	+	-
Rooms of exhaust ventilation of arch	-	-	+	+	
Storage site	+	+	+	+	-
Preliminary processing site	+	+	+	+	-
Preparation site	+	+	+	+	-
Platform (garage) Of crane maintenance in NSC	-	-	-	-	-
Zone 2					
Hot sanitary locks	+	+	+	+	-
Shops of technical maintenance and repair of equipment	+	+	+	+	-
Mobile DSS site	+	-	+	+	-
Shop of decontamination of equipment and components	+	+	+	+	-
Entrances to buildings inside NSC and hall ways	-	-	+	+	-
Routes of movements of personnel inside NSC in particular (access to OS and walls of DS	-	-	+	+	-
Site of storage of crane equipment an equipment for deconstruction	-	-	+	+	-
Vehicles Loading sites	+	-	+	+	-
Existing DSS site	+	-	+	+	-
Sites of monitoring of entrance and exit at northern and southern gates	+	-	+	+	-

ROOMS, SITES	WATER SUPPLY			SEWAGE	
	DOMESTIC AND DRINKING	HOT	FIRE	SPECIAL SEWAGE	INDUSTRIAL SEWAGE
Zone 3					
«cold» sanitary locks	+	+	+	+	-
Rooms of electrical panel and control panel	-	-	+	-	+
Radiation control shop	+	+	+	-	+
Office rooms	+	+	+	-	+
Entrances to auxiliary building outside NSC, hallways	+	+	+	-	+
Lockers, Relaxation rooms and shower rooms	+	+	+	-	+
Room of clean mechanical equipment	+	+	+	-	+
Rooms of input ventilation of sub-arch and annular space	-	-	+	-	+
Access orifices for vehicles outside NSC	-	-	+	+	-

3.7.8 FIRE SAFETY SYSTEM

CS-1 fire safety system design will include the CS-2 needs. The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.7.9 INTEGRATED CONTROL SYSTEM (ICS)

The NSC CS-1 Integrated Control System (top level) design will take into account the monitoring equipment and management systems for CS-2. It mainly concerns the Radiation Monitoring System (RMS) and the process monitoring systems. The following types of monitoring shall be considered for CS-1 RMS creation:

The monitoring in the deconstruction zone (for facilitation of interfaces with NSC CS-2)

Specially designed gamma-chambers are foreseen by NSC-CD to be used for determination of activity distribution in the deconstruction zones and detection of the high-level contamination on the dismantled structures in real time. This is an independent sub-system of RMS (inclusive of software). Obtained data (3D visual and gamma-image), and other parameters will be preserved in order to provide the integrity of data. Gamma-chambers are included into the CS-2 Contractor scope of work.

The monitoring on system of industrial vacuum-cleaner (for establishment of interfaces with NSC CS-2).

In NSC-CD the vacuum-cleaner consists of two hoses and two departments: one for low and intermediate radioactive waste, the other – for high level waste. Depending on the dose rate of the waste subject to collection by vacuum-cleaner, the operator shall select one of two hoses and thus direct the waste to one of two departments. In order to prevent the incoming of high level inclusions into the department for LLW and ILW on the hose of LLW&ILW department the gamma-radiation EDR collimated monitors shall be installed. Upon signal of these monitors the work of vacuum-cleaner will be stopped in case of hot particle detection, and the signal will be

transferred further to NSC control room. Also, the dust EDR detectors shall be installed in each department for dust collection. Upon exceeding of referenced levels the filling of departments will be stopped. These detectors refer to the CS-2 scope of work. Monitoring on gantry crane on site of preliminary processing (to establish interfaces with NSC CS-2)

NSC-CD foresees the use of beta-gamma monitors installed on gantry crane for examination of contaminated of elements of dismantled structures on site of preliminary processing aiming at making the decision on further processing or packing. Examination of elements shall be performed by way of scanning of the element's surface with even speed. The obtained data as EDR and density of beta-radiation flow diagram depending on point coordination will be transferred to control room. These detectors are included into CS-2 Contractor scope of work.

Radiation monitoring of barriers, technology processes, equipment.

In order to facilitate the monitoring of technology processes at violation of which sharp dust suspension increase may occur (deconstruction of unstable structures, fragmentation of dismantled structures, etc.), and of efficiency of barriers retaining the aerosol activity within the established limits, the stationary and/or mobile aerosol monitors shall be installed in vicinity of deconstruction zones and storage, preliminary processing and preparation sites for later performance by CS-2 Contractor. Selection of amount and locations of stationary and mobile aerosols monitors shall be defined by the nature of works to be performed and forecast of radiation situation change at dust suspension increase. The readings of aerosol monitors, visual and sound signals on exceeding the reference and permissible levels shall notify the personnel and be transferred to control room, and the visual signal shall be included into the card of technology process. It is possible to use the detectors' signals for automated management of technological processes. NSC CS-1 RMS design shall consider the future connections, in particular, to provide the tie-in points for equipment in vicinity of deconstruction zone and storage, preliminary processing and preparation sites.

NSC-CD envisages to install the stationary aerosol monitors in vicinity of deconstruction zones (OS roof). In particular the possible locations for installation are:

- cascade wall;
- roof of metal strengthening structure of western fragment;
- Turbine hall roof.

These detectors refer to the CS-2 Contractor scope of work. NSC CS-1 RMS design shall assume the connection of this equipment.

The design will stipulate capability to install additional equipment for management (from local boards or from central monitoring panel) of technological processes for deconstruction of structures, preliminary processing, preparation, loading and transportation, radiation monitoring of these technological processes.

Arrangement of the central control panel shall be designed to integrate additional equipment provided with CS-2 systems.

Physical protection system and access control

The NSC shall include 70 m^2 free room at the main entrance of the NSC auxiliary building for future installation of access control and physical protection equipments (turnstiles, card readers, etc.).

The system of physical protection and access control shall be designed considering the transportation and technological scheme of handling the dismantled structures and RAW which will be received from CS-2 Contractor.
The general requirements related to the composition and purpose of this system designed under NSC CS-1 considering NSC CS-2 are presented in Section 1.4 of CDSD.

3.8 RAW MANAGEMENT AND THEIR HANDING OVER TO CHNPP OBJECTS

Preparatory works for construction of the NSC facilities may be divided into the following categories [4.5.37]:

- Clearance of construction site;
- Engineering utilities arrangement on site;
- Arrangement of test sites for foundation fragments, support elements and joints, etc.;
- Actions addressed to arrange NOVARKA auxiliary facilities.

The following areas of the Industrial site with facilities, buildings and communication means situated there will be handed over to NOVARKA without preliminary preparation:

- Site for pre-assembling;
- Installation site;
- Site for the Western wall foundation and area for NSC auxiliary facilities.

ChNPP will hand over the sites for NSC foundations after the preliminary preparation of that area. Preparation of site, which should be done by ChNPP, will be limited by the following:

- Removal of berm of the “Pioneer” wall located at ~ 30 m to the South of the wall along Row A between Axes 38 and 56;
- Earthworks addressed to removal of the layer of backfilling (till absolute level of 113.5 m) within the “bands” of foundations.

It was preliminary defined that scope of earthwork for NOVARKA will include the removal of man-made layer of soil at the following sites [5.1.26]:

- Sliding ways, including the Northern and Southern ones;
- Installation area;
- Part of foundation of NSC Western wall from Row Г till the Northern sliding way within Axes 63-65;
- Part of foundation of NSC Western wall from Row A till the Southern sliding way within Axes 63-65;
- Part of foundation of Northern wall-end of the NSC Western wall till Northern sliding way within Axes 38-40;
- Part of foundation of the Southern wall-end of NSC Western wall from Row A till the Southern sliding way within Axes 38-40;
- Internal site of NSC ground floor to the North from Row A till the Northern sliding way between Axes 56 and 63 (West to Buttress wall);
- Internal site of NSC ground floor to the South from Row A till the Southern sliding way between Axes 40 and 63 (South to the Turbine hall).

Preliminary evaluated scope of the man-made soil layer to be removed under creation of foundation till the level of before-accident surface at the stated sites, is given in Table 3.8-1 [5.1.26]. Estimated distribution of waste by categories is very rough and cannot be used for the design development.

To provide earthwork, Contractor should conduct investigation of grounds as well as radiation conditions at the work implementation sites, arrange the territory, and remove or displace of surface and underground engineering facilities and communications, if required [4.5.37, 5.1.3].

Here, significant volume of contaminated soil and other materials as well as RAW of different groups (categories), including possible HLW and FCM, will be removed from the site designed for NSC construction.

Large RAW volumes will be generated during dismantling activity on VS-2 of II commissioning stage, and all its supporting structures. Moreover, during preparatory phases and NSC construction the secondary RAW will be generated caused by realization of measures providing for radiation protection of personnel (spent equipment, tools, PPE, decontamination solutions, waters from sanitary inspection rooms, etc.).

RAW management system during NSC construction will be a component part of overall RAW management system existing at ChNPP [4.2.1].

3.8.1 MANAGEMENT OF SOILS AND OTHER PROCESS MATERIALS

3.8.1.1 Characteristics of contaminated soils of the OS Local Zone and Industrial site

The following materials are included into the contaminated soils of the OS Local Zone and Industrial site:

- Core fragments;
- Extremely contaminated fragments of concrete;
- Sand and macadam;
- Fragments of concrete and debris;
- Fragments of metal structures.

Core fragments and the extremely contaminated fragments of concrete constitute the HLW and long-lived RAW. Probability of detection the HLW fragments is growing as approaching to OS.

Retained materials, at most, are considered to be intermediate level and low-level waste. Main volume of waste consists of non-metal waste representing filled-up ground (macadam, sand and gravel), concrete, concrete slabs and blocks, classified as low-level waste and intermediate-level waste.

Large dimension surface-contaminated RAW will be generated during dismantling of structures.

During NSC construction the main volumes of SRW will be generated under realization of the following types of activities:

- Earthwork (macadam, grounds, sand, fragments of concrete);
- Drilling activity (kerns, containing the above fractions);
- Demolition of different structures (structures and fragments of them).

Table 3.8-1. Assessment of soil volume to be removed under complete clearance of sites for NSC construction and the site layout under creation of the ground floor zone

Site for NSC foundations	Site square, m^2	Volume of ground to be removed, m^3, till absolute elevation*		Categories of waste and estimation of their amount, m^3 (% of total volume)**		
		114,0 m	113,6 m	HLW	ILW	NLW
1	2	3	4	5	6	7
South Area, sites:						
South-eastern	594	5730 (1280)	5960 (1330)			
Southern, including the site for “Demag”	3132	21210 (740)	22460 (960)			
South-western	594	5020 (1120)	5260 (1170)			
Total:	4320	31960 (3140)	33680	70 (0,2)	1800 (5,6)	The rest
North Area, sites:						
North-eastern	180	620 (220)	680 (280)			
North	1872	5280 (830)	6030 (1070)			
Total:	2052	5900 (1050)	6710 (1350)	30 (0,5)	720 (12,2)	The rest
West Area:						
Sliding routes, sites:						
Northern	1800	6480 (370)	7920 (450)			
Southern	1800	3240 (350)	3970 (530)			
Total:	3600	9720 (720)	11890 (980)	insignificant	insignificant	Whole scope
Installation area	11970	11970 (250)	16760 (470)	insignificant	insignificant	Whole scope
TOTAL	23076	71180 (8520)	81570 (9180)	120 (0,2)	3120 (4,4)	The rest

* - Assessed volumes and classification of grounds removed during creation of slopes and are presented in brackets. For sandy ground the ratio of slope is considered as 1:1 (ratio of height to width). In South area and the South-eastern and South-western sites, the slopes are considered to be 2m wide; at the South site the slopes are realized only from the Southern side (from Northern side excavation of soil is limited by “Pioneer” wall);

** - All the ground from slopes is considered to be LLW and has not been included in columns 5-7 of the Table.

3.8.1.2 Management of grounds and OS PM

Based on radioactive contamination, PM should be divided into three main classes (see Section 2.9) in accordance with values of radiation criteria (Table 3.8-2) [4.3.5]:

- Maximum exposure dose rate at distance of 0,1 m from PM;
- Specific activity of alpha-emitters – Avα;
- Specific volumetric activity of beta- and gamma-emitters – Avβγ;
- Specific surface activity with alpha-emitters – Asα;
- Specific surface activity with beta-emitters – Asβ.

Table 3.8-2. Values of radiation criteria for PM division into classes and types

Class of PM	Type of PM	EDR, mSv/h	$A_{v\alpha}$, Bq/kg	$A_{v\beta\gamma}$, Bq/kg	$A_{s\alpha}$*, part/cm² min	$A_{s\beta}$*, part/cm² min	Order of PM management	Trend of application
A	A-R[1)]	< 0,0003	< 100	< 10^4	n	n	Temporary storage by types within allocated area	Unrestricted
	A-S1-1	< 0,01	n	n	n	n		For backfilling under construction of the facilities [2)]
	A-S1-2	0,01 - 0,10	n	n	n	n		
	A-S1-3	0,10 - 0,30	n	n	n	n		
	A-S2	0,30 - 0,50	n	n	n	n		Disposal
	A-T [3)]	< 0,50	n	n	< 80	< 8000		
B	B	0,50 - 10	< 10^8	< 10^{10}	> 80	> 8000	Transfer to "Buryakovka" disposal site[4)]	Disposal
C	C	> 10	> 10^8	> 10^{10}	-	-	Collection into containers	Storage in HLW storage facility

Note:

n - it is not standardized

[1)] – PM of type A-R are not to be obligatory located at the site of temporary storage of PM;

[2)] - PM of type A-S1 are used for backfilling taking into account the levels of contamination in the places of foundation layout;

[3)] - Technogenic debris of concrete, metal structures and other similar materials;

[4)] - If acceptance criteria of RWTP "Buryakovka" are excessed, packing (containerization) and temporary storage should be conducted.

In corresponding working designs for preparation of infrastructure for NSC CS-1 construction CS-1 Contractor will develop and submit procedures for PM sorting in accordance with aforementioned criteria, and demonstrate in particular that the application of these procedures will allow separate PM with adequate accuracy to place PM at appropriate facilities for temporary storage or disposal. For PM use for backfilling during NSC CS-1 construction Contractor will also specify maximum size of man-made inclusions such as concrete fragments, etc. which could be a part of A-S1 and A-R PM types. These limitations on the man-made inclusions are also applied to A-S2.

3.8.1.3 Management of PM Category C (HLW)

HLW originates separate flow of waste. Retrieved HLW shall be handed over for containerization; then they should be certificated, loaded onto special motor-transport and transported for temporary storage. HLW management (after their detection) should be conducted by the Employer personnel [4.12, 4.37].

If case of identification of PM under Category C Contractor will inform the Employer about it and take appropriate measures on radiation protection for the personnel, as well as measures on non-spreading of radioactive contamination from the place of object location (till arrival of the Employer personnel).

Employer will ensure management of HLW, which were detected during construction, including the removal, fragmentation and handing over the containers into the storage facility. Removal of HLW shall be performed in term of not longer than 7 calendar days after their disclosure [4.3.3].

3.8.1.4 Management of PM Category B

Contractor will load Category B PM onto specialized vehicles and transport it to RAW disposal site Buryakovka. Before dispatching to RAW disposal site Buryakovka Employer is obliged to certify and register Category B PM in accordance with procedures and requirements listed in document [4.1.2]. Transportation is carried out in accordance with procedures and requirements to vehicles which are given in document [4.1.2]

Collected RAW will be transported for disposal RWDS “Buryakovka”. Volume of RAW received by RWDF “Buryakovka” is restricted with the terms and references of License and should not exceed 200 m^3 of waste per day.

3.8.1.5 Management of PM Category A

PM Category A will be loaded onto specialized vehicles separately from other PM types and transported to PM temporary site by the Contractor. Employer certifies and registers PM to be transported to PM site according to procedures and requirements listed in document [4.3.7]. Document [4.1.2] sets forth procedures and requirements to transportation means for transportation within ChNPP site. Transportation procedures could be simplified provided that Contractor arrange a special road between work areas and PM site for PM transportation only. Document [4.3.5] specifies acceptance procedures for PM site. Movement of grounds and PM to the site for temporary storage will be realized by Contactor in accordance with the prepared and specified traffic roads for routes of transportation where signs of warning and restriction had been installed.

Special transport loaded with soil and PM, which did not get the Employer permission for access to the site for temporary storage, Contractor would re-direct to RWDS “Buryakovka”.

Employer will be responsible for certification (recording of documents, required for transportation and storage of RAW) of all the types of radioactive waste.

3.8.1.6 Management of SRW, generated during NSC CS-1 construction

Contractor will collect and sort secondary, low-level and intermediate level SRW resulted from construction in work areas. Document [4.1.2] establishes requirements to collection and transportation SRW.

As secondary SRW are accumulated, Contractor will transport it to RWDS Buryakovka.

If during work implementation, the combustible or explosion - dangerous SRW are generated, they shall be collected separately, and before handling over for disposal they shall be converted into safe status, according to the specially developed programs.

3.8.2 LRAW MANAGEMENT

Current existing OS system of LRAW management provides for collection and removal of low-level and intermediate-level liquid waste, generated as a result of:

- Decontamination of rooms, equipment and tools;
- Decontamination of the additional PPE;
- Accumulation of precipitations, contaminated with radionuclide, in the lower premises of Turbine Hall and Deaerator Stack.

Arrangement of LRAW management is based on performance of the following operations: collection, temporary storage, and handing over for processing of LRAW [5.2.10, 4.3.2]. Principle scheme of OS LRAW collection and removal is presented in Figure 3.8-1.

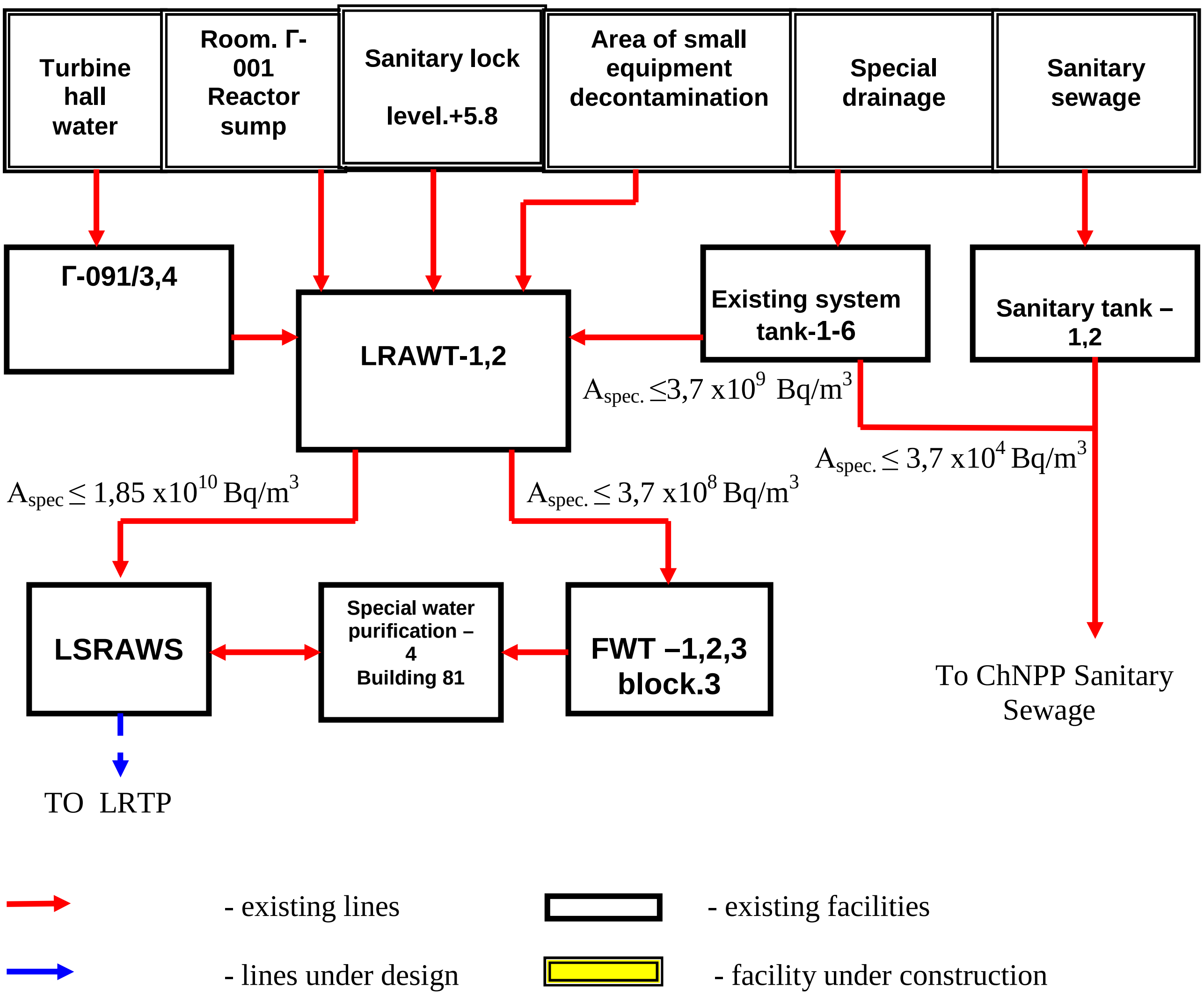


Figure 3.8-1. Existing scheme of OS LRAW collection and removal

Management of LRAW in Change Facility of BK-3 and SP -1430 is realized by the specific sewage system [5.3.1]. Waters after shower rooms and wash-stands are input into control tanks, where taking of samples and laboratory analysis of activity concentration of the samples is done before pumping. The decision on draining the water from the monitoring tank to the sanitary sewage shall be made if the content of individual radionuclide does not exceed the

permissible concentration established for publicly used water, or if the radionuclide-mix composition meets the requirement of the sum of ratios of the specific radioactivity of each individual radionuclide to its PC_B^{ingest} is under 1.

Low-level and intermediate-level liquid waste generated during OS operation and conversion (decontamination of rooms, equipment, pneumosuits and additional PPE, sanitary treatment of skin), as well as during ingress of precipitations into Turbine hall and DS rooms will be collected and removed, utilizing the existing system of LRAW collection and removal into Unit 3 collection system of drain waters for evaporation at SWC installations or into the LSWSF tanks for temporary storage of LRAW.

Vat residue from WCS should be directed for temporary storage into LSWSF tanks, in compliance with the existing procedures. Then, in accordance with the Design and technology of LRAW processing in LRTP, it is foreseen to direct the vat residue to LRTP for processing (utilizing the commissioning facilities for LRAW removal from tanks of LWS and LSWSF). Solid LIL-SLW, packed into 200-l drums will be the final product of LRAW processing. It is designed to direct drums for disposal into the near-surface storage facility (ICSRM) under construction.

At the facilities which are the part of NSC CS-1 and which are non-connected with the LRAW collection system, collection of generated LRAW will be arranged into the specific reservoirs. Contaminated waters, collected into those reservoirs, will be carried to the drainages and discharge of waters into tanks for drain waters.

Low-level waste, generated during decontamination of structural engineering, specific motor transport and containers for RAW and other equipment will be collected in special reservoir. After reservoir is filled in with spent solution, the personnel of RSS will take samples and run on-line monitoring of contaminated waste generated. If specific activity of solutions in reservoir does not exceed reference concentration – 7 Bq/l by ^{137}Cs, then personnel of ChNPP will pump the spent solution to the tank-truck for further removal into the sanitary sewage (faecal). If the specific activity of the solutions exceed the reference level, tank-truck is transported to the sewage pump station of AB-3, where its contents are loaded out into the tank of special sewage system.

Transportation of filled tank truck within ChNPP site is performed according to approved traffic routes. Employer registers generation and acceptance of LRAW transported by tank trucks.

Removal of LRAW from the NSC to the ChNPP systems will be designed in accordance with [5.2.10].

3.9 SUFFICIENCY OF THE INITIAL DATA FOR THE NSC CS-1 DESIGN

3.9.1 GENERAL PROVISIONS

From the above sections, NOVARKA states that:

- The geographic and climatic characteristics described in Section 3.1.1 are used in the design for:
  - The dimensioning of the steel structure, roofing, foundations and other extrernal concrete surface elements;
  - The definition of the ventilation flow rates and the capacity of the heating and air conditioning systems;
  - The safety assessment of the impact to population of radioactive releases.

  Together with the documents referenced in 3.1.1, these initial data are sufficient for the design.
- The seismic characteristics of ChNPP site presented in Section 3.1.2 and in Section 2.3 will be used to design the seismic resistant SSC. These initial data, together with the safety classification and the associated design criteria, are sufficient for the Design.
- The initial data provided in Section 3.1.3 on geotechnical and hydrogeology are used for the design of the foundations and their piles. Although they are exhaustive, they appear to be outdated and require additional site investigations for confirmation and/or updating. The procedure for these site investigations is provided in next section.
- The set of information from Section 3.1.5 on site arrangements provides the initial data needed for:
  - The identification of man-induced external events and their parameters;
  - The provisions for emergency planning;
  - The means available on site to ensure personnel and materials transportation to the site.

  This set of information together with the documents referrefd to (in particular the Shelter Emergency Plan) is sufficient to perform the Design.
- The set of information from Section 3.2 on temperature and humidity in the Shelter rooms provide sound description of the current situation inside the OS. They provide consistent initial data which will be used to design the ventilation system and, therefore, consider the condensation-related hazards. These initial data are sufficient for the Design of the Ventilation System;
- The information included in Section 3.3 provides detailed description of volumetric and design solutions of the NSC and its associated equipment. These data are insufficient for the Design of the NSC. The following section presents the way NOVARKA plans to complement them with specific survey campaigns.
- The information included in Sections 3.4 and 3.5 on radiological conditions are insufficient for the Design of the NSC and construction activities. The following items of information are lacking:
  - Dose rates in altitude away from the OS with multiple contributions from all the facilities located around, in particular the PM lay-down area;
  - Dose rates in altitude in the future location of the cranes and crane rail tracks;

The following section presents potential strategies to acquire or simulate the missing information.

- Section 3.6 related to the interfaces with the object Shelter are insufficient for the Design. The following items have to be addressed:
  - The outlet of the storm sewage system requires specification and adaptation considering the increasing of the precipitation amounts;
  - The outlet of the special sewage system is still undefined as the deconstruction building is not defined as it is not clear that waste processing facilities like the LRTP will be available after the final commissioning of the NSC;
- Similarly Section 3.7 identifies numerous arrays of interface with CS-2 which require implementation of effective coordination procedure between NOVARKA and the CS-2 contractor to be designated by the Employer.
- Apart from what it has been stated above on the availability of planned future radioactive waste management facilities, the information presented in Section 3.8 are sufficient for the Design.

Table 3.9-1 presents the summary data related to the assessments of hazards for design, necessary scope of additional research and the initial information provider.

Table 3.9-1. List of initial information for design

#	LIST OF FORECASTED HAZARDS	WORKS ON DESIGN AND CONSTRUCTION ACCOMPANIMENT	USE OF RESULTS	AVAILABILITY OF EXISTING INFORMATION /NECESSITY OF OBTAINING OF ADDITIONAL INFORMATION
1.	Hazard of overloading of NSC structures with loads:			
	– snow (extreme)	• Specification of regularities of snow deposit considering the scale of facility (experimental research in wind tunnel).	Initial data for design of NCS at stages «Design» and «Working documentation».	The tests are required, the initial information is sufficient
		• Specification of extreme value of snow load for recurrence period once in 10000 years due to the fact that snow loads per SNiP 2.01.07-85 are significantly underestimated.	Initial data for design of NCS at stages «Design» and «Working documentation».	The initial information is sufficient

#	LIST OF FORECASTED HAZARDS	WORKS ON DESIGN AND CONSTRUCTION ACCOMPANIMENT	USE OF RESULTS	AVAILABILITY OF EXISTING INFORMATION /NECESSITY OF OBTAINING OF ADDITIONAL INFORMATION
		• Specification in experiments of conditions of snow sliding from the inclined surfaces, including the effect of "sudden sliding" in order to consider the dynamic impacts under snow and ice descent from the roof	Determination of dynamic loads on NCS structures	The tests are required, the initial information is sufficient
	– Wind (extreme)	• Creation of NSC model and its tests in wind tunnel; obtaining of data on distribution of aerodynamic performance on coating under wind impacts, including during sliding.	Initial data for design of NCS at stages «Design» and «Working documentation».	The tests are required, the initial information is sufficient
	– Tornado	• Experimental assessment of tornado impacts on NSC surface.	Initial data for design of NCS at stages «Design» and «Working documentation».	The tests are required, the initial information is sufficient
	– Seismic	• Studies of dynamic features of base grounds.	For implementation of dynamic calculations of system "arch – foundation – base".	Additional survey is required by NOVARKA
2.	Hazard of over-normative deformation of coating in locations of supports of suspended cranes under unfavourable combinations of loads and impacts.	• Verification of possibility of ordinary operation of cranes with capacity 40tf from condition of deformability of coating in locations of suspensions.	Initial data for design of NCS at stages «Design» and «Working documentation».	Tests are required, initial information shall be obtained from crane manufacturer
3.	Hazard of failure to meet the	• Selection of steel for basic structures,	Initial data for design of NCS at	The necessary data may be obtained after

#	LIST OF FORECASTED HAZARDS	WORKS ON DESIGN AND CONSTRUCTION ACCOMPANIMENT	USE OF RESULTS	AVAILABILITY OF EXISTING INFORMATION /NECESSITY OF OBTAINING OF ADDITIONAL INFORMATION
	requirements of design durability for materials applied in NSC.	determination of its physical and mechanical properties and durability; • Selection of corrosion coating, study of its protective properties, resistance to potential impacts and durability; • Study of durability and assessment of resource of plastic suspended panels of ceiling;	stages «Design» and «Working documentation».	calculation of loads and justification of of additional criteria Tests of materials are required under OS site conditions by NOVARKA Tests are required considering the criteria of radiation impacts

#	LIST OF FORECASTED HAZARDS	WORKS ON DESIGN AND CONSTRUCTION ACCOMPANIMENT	USE OF RESULTS	AVAILABILITY OF EXISTING INFORMATION /NECESSITY OF OBTAINING OF ADDITIONAL INFORMATION
4.	Hazard of exceeding of radiation impact on the workers under NSC construction	• Determination of spatial distribution of radiation fields in the NSC assembly. • Determination of spatial distribution within the limits of fencing structures. • Determination of radiation features of soils in the area of assembly site. • Determination of spatial and angular features of radiation sources. • Analysis of potential emergencies at facilities on RAW handlingon ChNPP site (LRTP, ICSRM, SFS-1,2), Units 2 and 3, OS	Initial data for assessment of radiation impact on the personnel and recommendations on selection of technology operations and works for dismantling of structures, shemes of assembly and sliding, requirements , to ventilation system.	Additional studies in working areas are required. Will be obtained by NOVARKA at stage of WEP development. Work will be implemented after development of the radiation survey program development, which defines the scope of survey based on SAR, EIR and SCR development Information will be obtained from the Employer after development of technical decisions on existing structure strengthening Will be obtained by NOVARKA Information shall be provided by the Employer Initial data are insufficient. Information to be provided by the Employer Initial data are insufficient. Information to be provided by the Employer or performed by own forces after determination of working areas. Initial data are insufficient, analysis of SAR of ICSRM, LRTP, and SFS-1,2, projects. Emergency plan of ChNPP. Information to be provided by the EMployer
5.	Hazard of loss of the bearing capacity of	• Conduction of thermal and dynamic	Initial data for design of NCS at	Initial data are available. If required, Employer shall

#	LIST OF FORECASTED HAZARDS	WORKS ON DESIGN AND CONSTRUCTION ACCOMPANIMENT	USE OF RESULTS	AVAILABILITY OF EXISTING INFORMATION /NECESSITY OF OBTAINING OF ADDITIONAL INFORMATION
	steel structures in case of fire.	analysis of probable internal maximum fire aiming at determination of required limit of fire-resistance of NSC structures, assessment of risks and consequences of explosion inside NSC and determination of «neutral» smoke zone.	stages «Design» and «Working documentation».	provide the additional information on sources of fire and limitations of its impact on the NSC structures.
6.	Hazard of insufficiency for NSC of composition and scope of investigations foreseen by SNiP 1.02.07-87 «Engineering investigations for construction»	• Implementation of the set of field and laboratory investigations on studying of lithological composition and physical and mechanical features of bases in the zones of NSC leaning and in the locations of assumed arrangement of foundation slabs on the natural and pile bases.	Initial data for design of NCS at stages «Design» and «Working documentation».	Works are planned and under implementation by NOVARKA
7.	Hazard of radioactive and biological contamination of the underground waters during arrangement of pile foundations .	• Safety studies of application of the known methods of drilling works and their permissibility under ChNPP site conditions.	Initial data doe design of work implementation under ChNPP site conditions.	Analysis of initial information about state of ground waters and confirmation of the data on gamma-logging during vertical planning of the foundations, additional data will be obtained during wells drilling, scope of works is defined.
8.	Hazard of overloading of layers of leaning of the pile foundation under their fast loading with moving facility	• Modelling of dynamic behavior of the base.	Initial data for design of pile foundations and determination of NSC sliding speed	Initial data will be obtained in the result of additional geotechnical investigations of site and field tests of piles by NOVARKA

#	LIST OF FORECASTED HAZARDS	WORKS ON DESIGN AND CONSTRUCTION ACCOMPANIMENT	USE OF RESULTS	AVAILABILITY OF EXISTING INFORMATION /NECESSITY OF OBTAINING OF ADDITIONAL INFORMATION
9.	Hazard of occurrence of horizontal deformations of pile foundations on the vertical piles which are higher than designed ones.	• Field test of individual piles on the combined impact of vertical and horizontal loads. • Modelling of work of the system «arch-foundation-base».	Initial data for design of foundations on stage of «Working documentation».	Data will be obtained after modeling of work of the system, obtaining of additional data on geotechnical investigations and field tests of pile by NOVARKA
10.	Hazard of accident – man-made layer as a real source of radioactive contamination of the underground waters.	• Implementation of special set of geophysical and hydrogeological works, necessity of which is caused also by necessity of development of NSC EIR.	• Materials for NSC EIR section. • Creation of the new system of monitoring of underground waters	Data will be obtained from the Employer Analysis will be performed after the investigations
11.	Hazard of breakage of the NSC sliding process and accident-free operation of assembly rigging, equipment, tools	• Creation of large-scale operating model of the arch (1:20...1:30 of natural dimensions) with sliding ways. • Performance on the model of a set of static and dynamic tests. • Modelling of technological operations.	Initial data for design of Work execution.	Initial data will be obtained after determination and calculations on loads
12.	Hazard of breakage of synchronous operation of two cranes with balancing traverse	• Working-off on the physical models of cranes and traverse of the processes of joint operation of the cranes.	Initial data for design of NCS at stages «Design» and «Working documentation».	Initial data will be obtained from CS-2 (via SIP-PMU)
13.	Hazard of occurrence of unremovable defects in the suspended cranes during their multi-	• Study on operational reliability of the materials, joints, equipment cranes.	In order to specify the volumetric and planning solutions of NSC	After specification of the requirements for the systems the necessary parameters will be determined, initial data on

#	LIST OF FORECASTED HAZARDS	WORKS ON DESIGN AND CONSTRUCTION ACCOMPANIMENT	USE OF RESULTS	AVAILABILITY OF EXISTING INFORMATION /NECESSITY OF OBTAINING OF ADDITIONAL INFORMATION
	annual idle times between the work cycles.			temperature is available
14.	Uncertainty in organization of works on decontamination of suspended cranes before conduction of regular and repair works.	• Experiment on decontamination of crane structures.	Initial data for design of NCS at stages «Design» and «Working documentation».	Calculations on variations of radiation situation after roof removal, initial data from CS-2 will be obtained from Employer
15.	Hazard of OS structures collapse	• Data on OS structures state considering the stabilization measures, scenario of accident with collapse of localising shell (OS safety status report)	Initial data for design of NCS at stages «Design» and «Working documentation».	Sufficiency of information will be assessed after the final report on stabilization safety and OS SSR from the Employer
16.	Hazard of Turbine Hall collapse	• Data on Turbine Hall state (scenario of TH structures collapse accident, radiation parameters of TH structures)	Initial data for design of NCS at stages «Design» and «Working documentation».	No initial information, Will be obtained from Employer.
17.	Hazard of impossibility of satisfactory clearance of NSC claddings from radiation contamination.	• Study of operational reliability of the materials of claddings	Initial data for design of NCS at stages «Design» and «Working documentation».	Will be performed by NOVARKA
18.	Hazard of insufficient consideration of interfaces of CS-1 and CS-2 during development of systems and sites for preparation and primary processing of dismantled structures	• Data on the necessary tie-in points, transportation technological scheme of RAW handling, etc.	Initial data for design of NCS at stages «Design» and «Working documentation».	Исходную информацию предоставит ГУП ПОМ от Подрядчика ПК-2

#	LIST OF FORECASTED HAZARDS	WORKS ON DESIGN AND CONSTRUCTION ACCOMPANIMENT	USE OF RESULTS	AVAILABILITY OF EXISTING INFORMATION /NECESSITY OF OBTAINING OF ADDITIONAL INFORMATION
19.	Hazard of occurrence of significant flows of condensate inside NSC at failure of system of regulating of temperature and moisture regime.	• Modelling of temperature and moisture regime under extreme situation. • Assessment of seasonal fluctuation of temperature inside NSC and influence of these fluctuations onto NSC structures, operations of plant and mechanisms, OS structures and durability of both facilities.	Initial data for design of NCS at stages «Design» and «Working documentation».	Initial information is sufficient, additional data will be received after modeling of temperature and moisture regime

3.9.2 MISSING DATA AND PROGRAM TO ACQUIRE THEM

3.9.2.1 Soil properties and characteristics

From the above assessment, it appears that the soil characteristics provided in this chapter are insufficient and outdated for the Design of the piles and foundations. In particular, the set of available information related to the local zone requires supplementing. Nevertheless, carrying out any survey in this area would induce significant exposure to radiation. Moreover, the lumps of concrete which are buried superficially in the areas where the foundations will be constructed present peculiar obstacle for implementation of surveys until they are not removed.

NOVARKA is carrying out soil investigation campaign in the Industrial site based on pressuremeters and cone penetration (CPT) tests in order to identify the load bearing capacity of the NSC. This soil analysis will provide updated values which will be compared to the values available. If the two sets of information provide values of the same order of magnitude, the differences identified will be extrapolated to the values available for the Local Zone. The extrapolated values for the Local Zone will be used for the design until the lumps of concrete are removed (operation planned during the earthworks activities).

Once this is done, NOVARKA would carry out additional CPT surveys (static probing) to confirm the Design and check its consistency with the new set of information acquired.

As a whole, the site investigation works will consist of:

- 46 Static cone penetration test (CPT) down to the level of ground waters (6-8m) and to the depth of 25m from elevation 114.0;
- 2 Pressuremeter tests every metre from 4.00 m down to 34.00m from elevation 114.0.

The purpose of these investigations in as follows:

- division of the geological section into engineering and geological elements (EGE);
- assessment of spatial variability and properties of soils;
- assessment of the density of sands per Attachment 4 to SNiP 1.02.07-87;
- rough quantitative assessment of characteristics of mechanical soils (module of deformation, angle of internal friction, cohesion) per Attachment 4 to SNiP 1.02.07-87.

In the process of works the measurement of specific resistance of the soil under the tester cone (q_c, MPa) and specific resistance of soils at the site of side surface (frictino coupling) of tester (f_s, kPa) will be performed.

The following will be obtained in the result of static probing:

- Tables of variations per depth of q_c, MPa and f_s, kPa;
- Charts of variation per depth of specific resistance of soil q_c, MPa and f_s, kPa;
- Rough values of module of deformation E, angle of internal friction and φ of specific cohesion of sand soil and loamy soils.

The works will be performed under special program with justification of safety during work implementation.

3.9.2.2 Geographic arrangement and geometrical data

Geographical uncertainties and lack of precision in the location of the existing Object Shelter on site will be corrected by NOVARKA in the frame of overall survey campaign.

This survey has started at the earliest phase of the project by performing complete 3D-Scanning of the Shelter and surrounding facilities. This scanning provided accurate geometrical dimensions of the facility with accuracy of the order of magnitude of tens of millimetres. The next step of this campaign is to calibrate this scan with perfect geopositioning using GPS Aerial. This aerial is positioned at the moment of the CDSD development.

The complete information would allow accurate positioning of the NSC compared to the Shelter and the foundations to the NSC itself.

Besides, NOVARKA plans to obtain from the Employer the initial information related to the realization of all the projects on site and after analysis to use this information for development of the general layout.

Also, it is planned to receive from AEZ the information on the transport mains, the state of port facilities in Pripyat town, engineering networks in the Exclusion Zone for development of the transportation scheme of delivery and storage of materials.

3.9.2.3 Radiological information

The radiological information is missing or outdated. Because of the complexity of the radiation conditions (see Section 3.4), extrapolating calculation results or establishing detailed 3D mock-up of the radiation sources inside the Shelter and around considering self-attenuation and other factors is not relevant. Therefore, survey campaigns are planned to obtain at least:

- The radiation dose rates at ground level at the location of the infrastructure facilities will be carried out by qualified personnel and subcontractors using mobile equipment calibrated and certified;
- For the radiation dose rates and contamination levels inside the industrial site and local zone, the daily measurement performed by ChNPP will be used during the Design and further, during the work execution;

- For the radiation dose rates in altitude at the location of the arch assembly area, specific campaigns will be carried out using radiation monitors positioned in height using appropriate hoisting mechanisms. An option for such mechanisms is balloons used with the same modus operandi as the campaign carried out before the stabilisation works;
- Similar altitude campaign will be carried out in the local zone in order to determine the dose rate at the location of the main cranes and the gangways located in the annular space;
- The dose rate and contamination levels in the locations of the Arch abutment to the existing structures of OS and in the zones of work implementation to be defined after Design development;
- The dose rate and contamination levels in Turbine Hall, etc.

The Employer shall provide all tha available information by request of NOVARKA. In case of absence of such information, the Employer shall facilitate its obtaining and provision. If NOVARKA requires the necessary additional information it will be obtained by NOVARKA, or by subcontractor based on the Safe Work Execution Program.

3.9.2.4 Interface with CS-2

Defining the interfaces with the CS-2 project will not be fully possible until a contractor is designated to carry out the respecting design. In the mean time, NOVARKA will design the NSC with the initial data defined in Section 3.7 and will derive criteria for the CS-2. Once the CS-2 contract is awarded, coordination is to be set up between both contractors under the umbrella of ChNPP with the lead of SIP-PMU.

This coordination will aim to state on the feasibility of the tie-ins between CS-2 and CS-1 equipment, the capacity needed by CS-2 equipment and other design requirements which can be induced by CS-2 concepts which might differ from the dismantling scenario and tools defined during the NSC Conceptual Design.

3.9.2.5 Fencing Structures State

The studies shall be performed in the following directions:

- Study of the radiation situation in the working zones and along the routes;
- Examination of the state of structures to be used in composition of fencing contour of NSC;
- Examination of the technical state of working zones where the works on strengthening of existing structures and/or erection of the new ones will take place;
- Examination of availability of explosive and fire-hazardous materials in working zones;
- Examination of the personnel access ways;
- Examination and identification of the freight movement routes.
- In the result of examination of access ways and working zones the following parameters shall be obtained:
- maps of equivalent dose rate in working zones and equivalent dose rate values along the access ways;
- spatial distribution of equivalent dose rate during the works at various elevations;
- energy and angular distributions of gamma-radiation in the zones with high values of equivalent dose rate where the significant scope of works will be performed and the use of shielding is possible;

- availability of location and features of found local sources of radiation;
- levels of full and removable radioactive contamination of surfaces;
- characteristics of aerosol air contamination – contents of radioactive aerosols in the air, their radionuclide composition and physical and chemical features. Since during the work implementation the aerosol concentration increases drastically, the availability of estimated values for balanced element in the NSC volume.
- The similar information shall be obtained for the personnel access ways. Besides, the information on the possible zones of OS structures collapse. The Employer shall provide information prior the main facility design effort start.

3.9.2.6 Accident Scenarios

After obtaining the OS SSR from the Employer the analysis of completeness of the initial information on the OS structure collapse for its consideration during NSC+OS SAR development. At this, the information shall be assessed based on the following parameters:

- availability of the initial data for accident modelling;
- completeness of the scenarios of accident evolution (event trees, probabilities of the initial and intermediate events, reliability of the probabilistic assessments, assessment of the radiological consequences);
- dose loads at realization of individual scenarios of the accident;
- organizational and technical measures on preventions, development and limitation of the accident consequences.
- During analysis the attention shall be focused on the accident with collapse of the elements of localising facility, structures of abutment and Turbine Hall. If absent or incompleteness of the stated above information the Employer shall be notified on the necessity of its provision.

3.9.2.7 Initial information for modelling

- As marked in Table 3.9-1, portion of information is required for modelling. Such information may be obtained on the mock-up of NSC which will be the subject for additional studies in wind tunnel. Besides, in order to justify the reliability of foundations, the in-situ tests of pile shall be performed. These tests will be performed under individual programs the results of which will be provided to Employer for analysis. Based on this information the additional criteria listed in Section 4.6.3 will be specified.

3.9.2.8 Transportation and technological scheme of RAW handling

- In order to develop the transportation and technological schemes of RAW handling and specification of the design criteria for LRW and SRW handling systems, the Employer shall provide the following information:
- Documents related to the facilities under construction on site intended for RAW handling (LRTP, ICSRM, temporary storage of HLW and LLW, SFS-1), and the safety analysis reports;
- Criteria of RAW acceptance to and from these facilities;
- Documents for existing at OS systems of LRW and SRW handling;
- Information on installations on LRW purification from TUE (technology schemes, time of operation start, analysis of their efficiency, etc.);

- HLW handling procedures;
- Procedures of RAW transfer to RWDS Buriakovka;
- Installation for decontamination of equipment, transport means (including Exclusion Zone).

ATTACHMENTS TO CHAPTER 3

A3.1 – SCHEMES OF CHNPP AND OS SITES

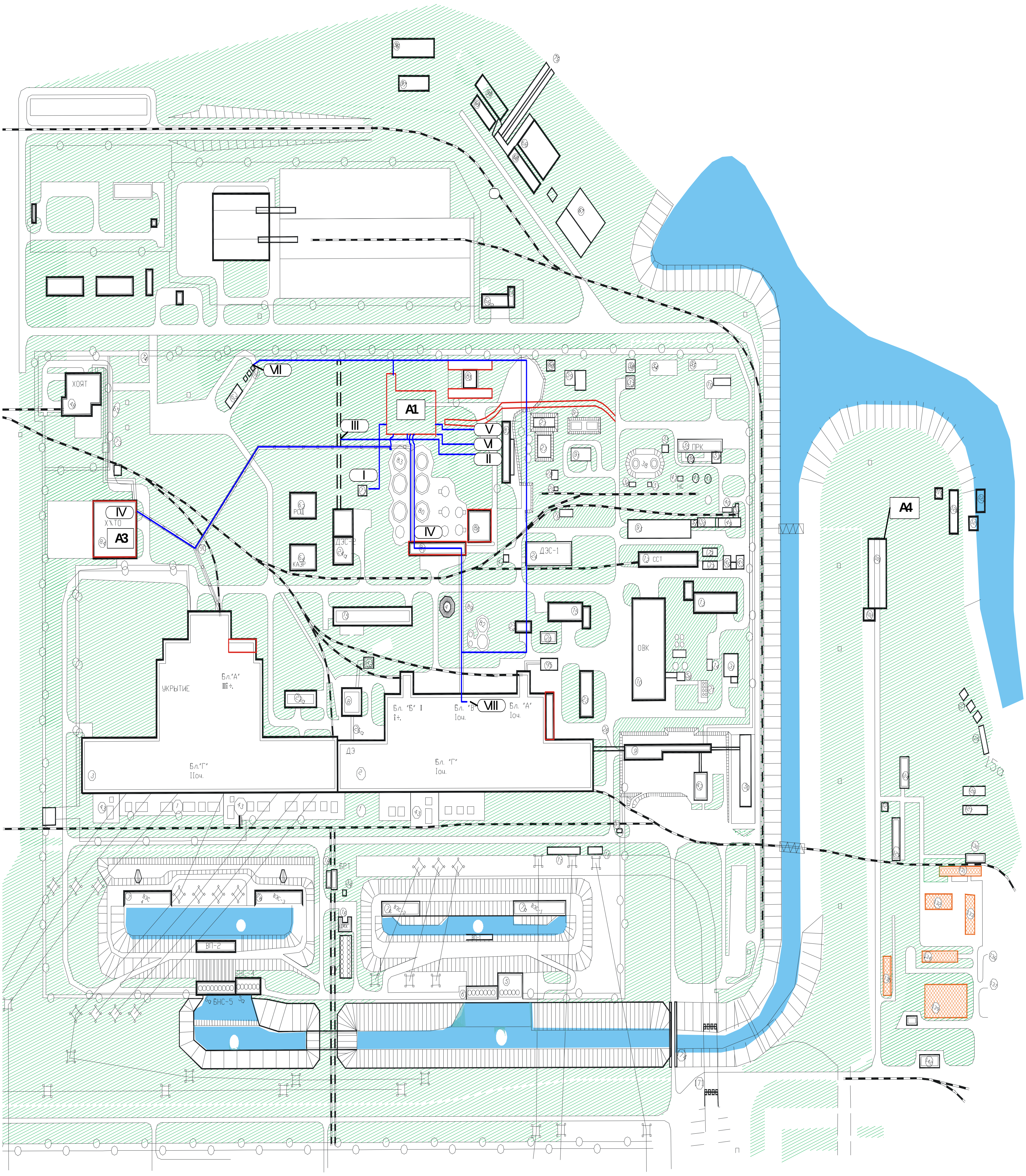


Figure A3.1-1 – Scheme of ChNPP Site

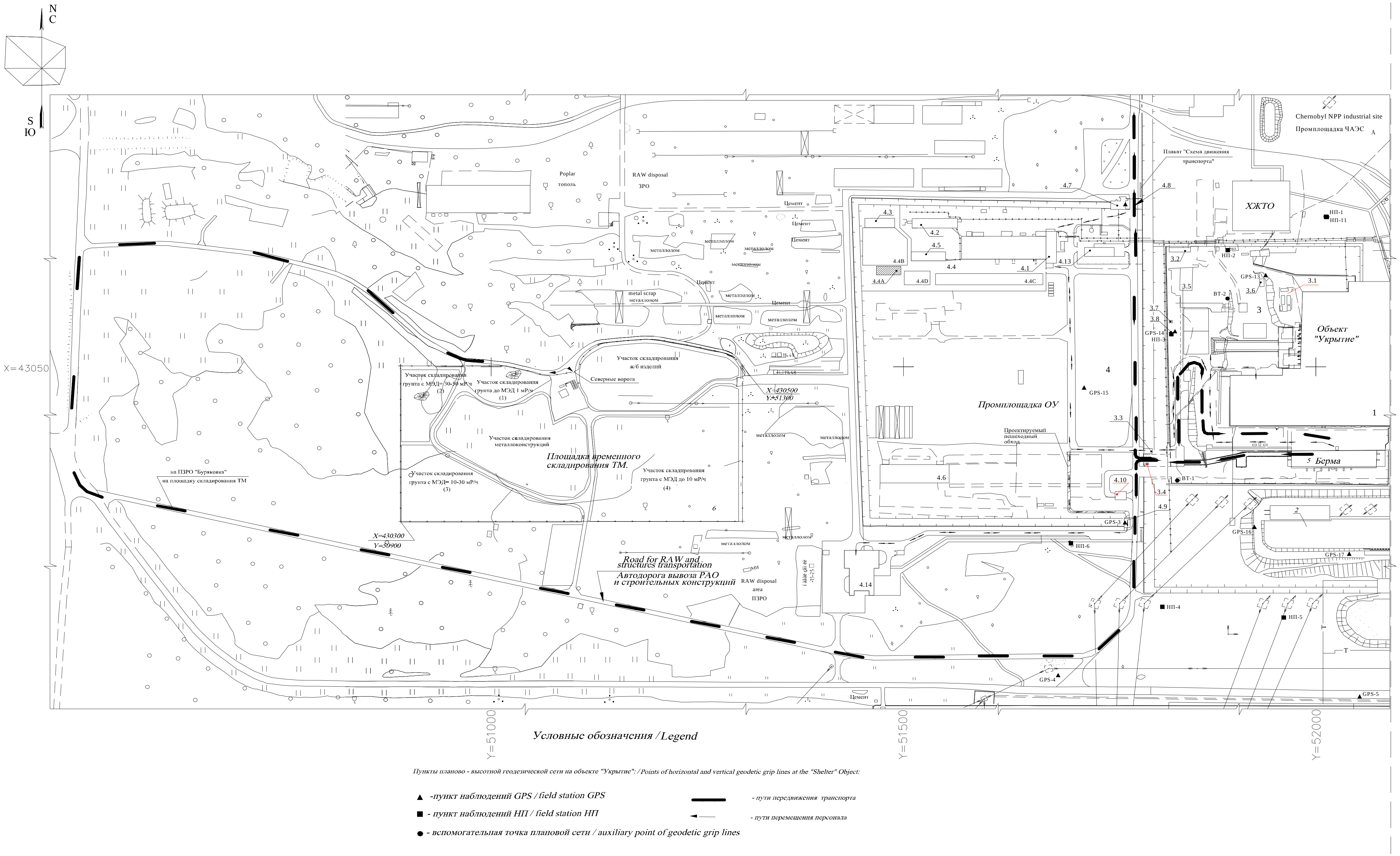
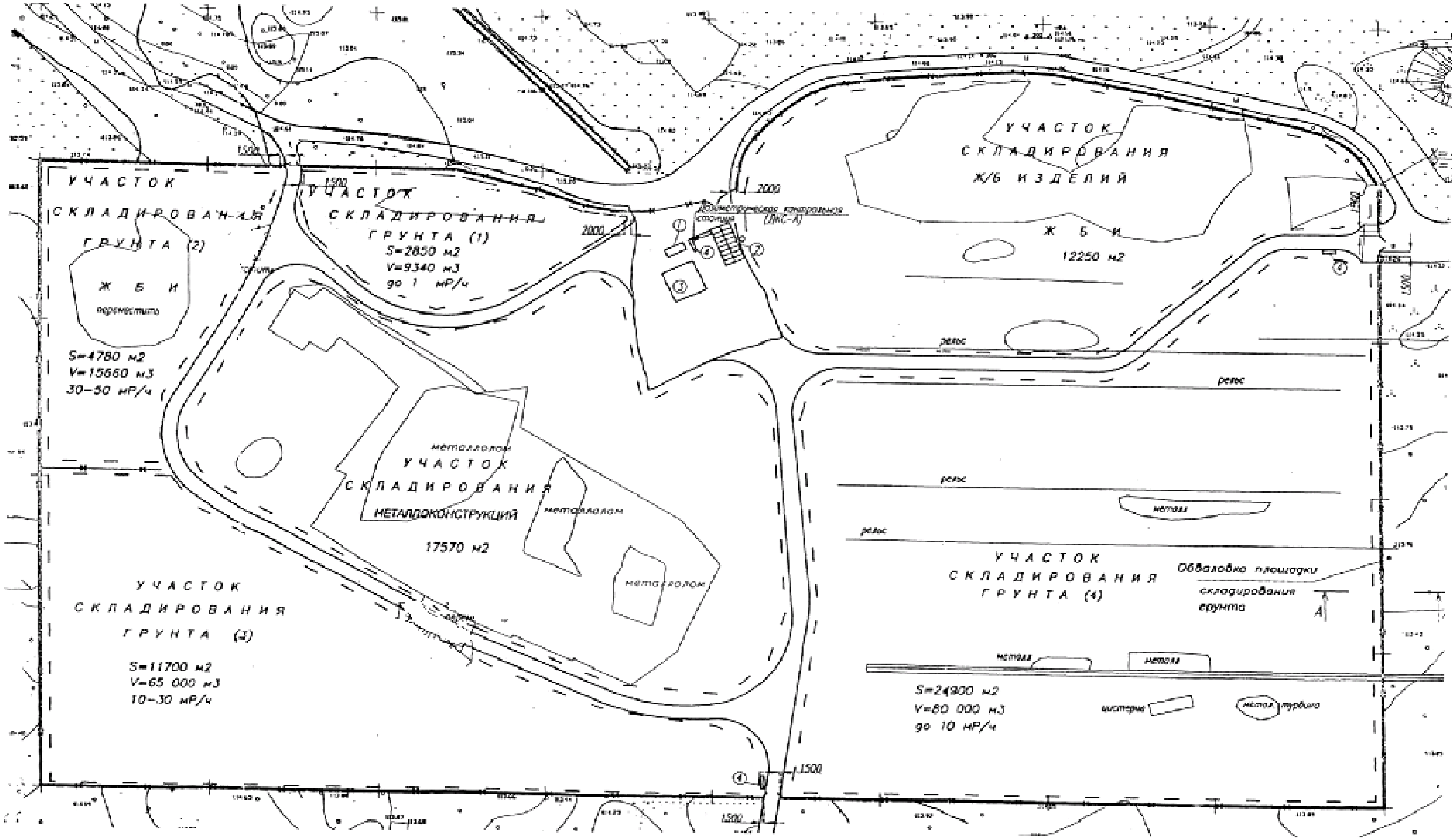


Figure A3.1-2 – Scheme of OS Site and Local Area

Table A3.1-2 List of OS buildings and structures on Figure A.3.1-2

№	Наименование / Name
Существующие здания и сооружения / Existing buildings and structures	
1	Объект «Укрытие» / Object Shelter
2	Напорный бассейн / Pressure basin
3	Локальная зона ОУ / Object Shelter local zone
3.1	Участок приготовления пылеподавляющего состава / Area for dust suppression compound preparation
3.2	Буровой участок / Drilling area
3.3	Контрольно-пропускной пункт № 4 для прохода персонала автотранспорта / Control and admission point №4 for personnel passage
3.4	Контрольно-пропускной пункт № 5 для проезда автотранспорта / Control and admission point №5 for transport passage
3.5	Склад ТМО (основной) / HME storage area (main)
3.6	Склад ТМО (склад арматуры) / HME storage area (rebars storage area)
3.7	Осветительная мачта / Lighting mast
3.8	Геодезический пункт / Geodetic station
4	Промплощадка ОУ / Object Shelter industrial site
4.1	Санпропускник на 600 мест / Changing facility for 600 places
4.2	Административно-технический корпус цеха технологического обслуживания Укрытия (АТК ЦТОУ) / Administration and engineering building of the shelter technological department (AEB STD)
4.3	Склад ЛВЖ и ГЖ / VFL and FL storage facility
4.4	Центр подготовки персонала / Personnel training center
4.4A	Учебный корпус / Training building
4.4B	Открытая площадка для макетов / Open mock-ups site
4.4C	Навес для макетов / Shed for mock-ups
4.4D	Площадка для противопожарной подготовки / Fire prevention training site
4.13	Здание караульной службы / Guard building
4.14	Санпропускник на 1430 мест / Changing facility for 1430 places
4.5	Склад для хранения металла и стройматериалов / Metal and construction materials storage facility
4.6	Склад графита / Graphite storage facility
4.7	Смотровой павильон и КПП № 13 для прохода персонала / Observation pavilion and control and admission point №13 for personnel passage
4.8	Контрольно-пропускной пункт № 14 для проезда автотранспорта / Control and admission point №14 for transport passage
4.9	Контрольно-пропускной пункт № 15 для проезда автотранспорта / Control and admission point №15 for transport passage
4.10	Установка дезактивации/Decontamination facility
5	Берма пионерной стены/Pioneer wall berm
6	Площадки временного складирования грунта/ Temporary soil storage site



1 – Dosimetric check-point; 2 – Open area for car washing; 3 - Parking place; 4 – Inspection site for radiation checking of traffic

Figure A3.1-3 – Allocation scheme of temporary soil storage site

A3.2 – SCHEMES OF COMMUNICATIONS OF CS-1 NSC SYSTEMS TO INFRASTRUCTURE FOR CHNPP

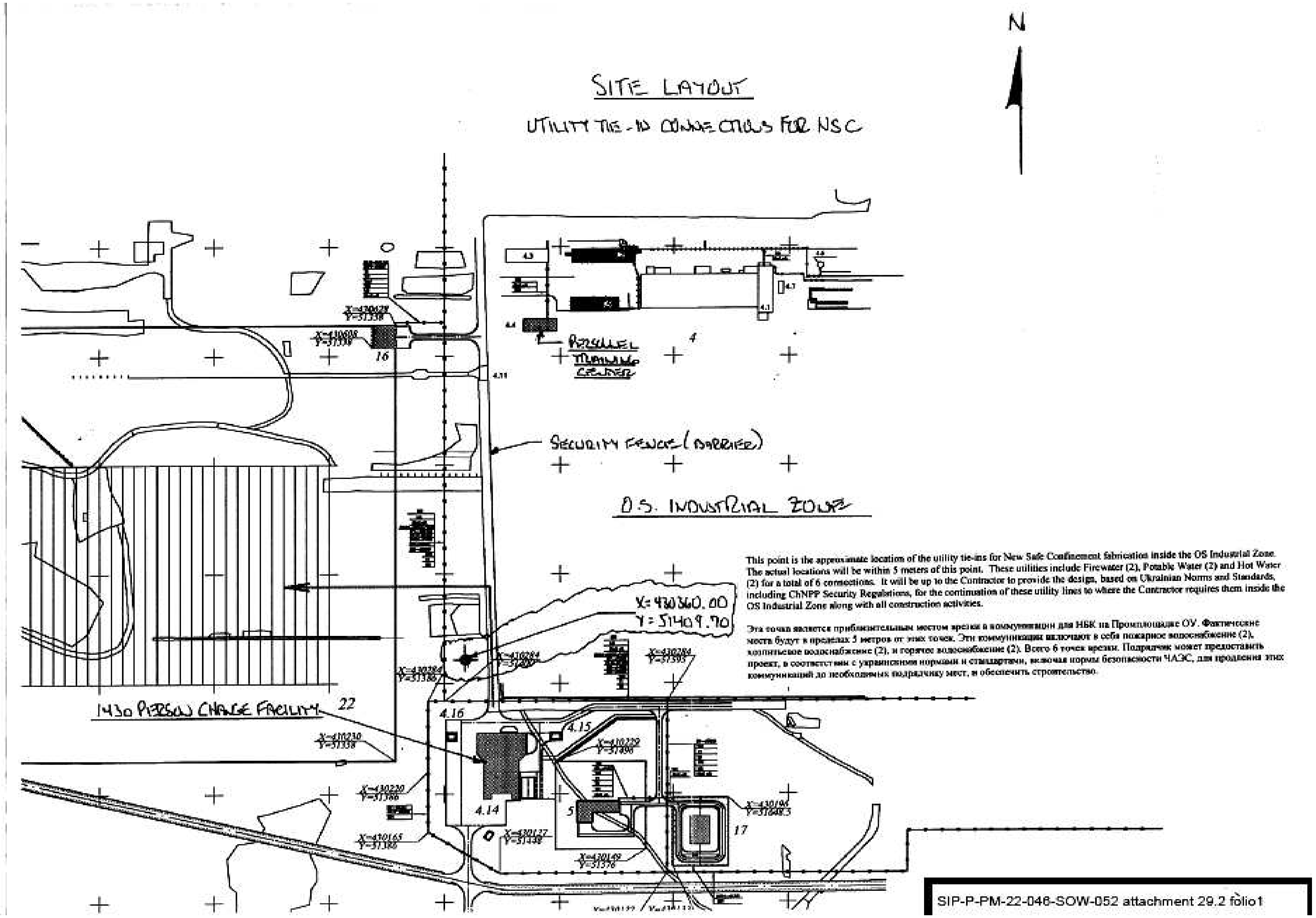


Figure A3.2-1 – Scheme of external communications of household water, hot and fire water supply

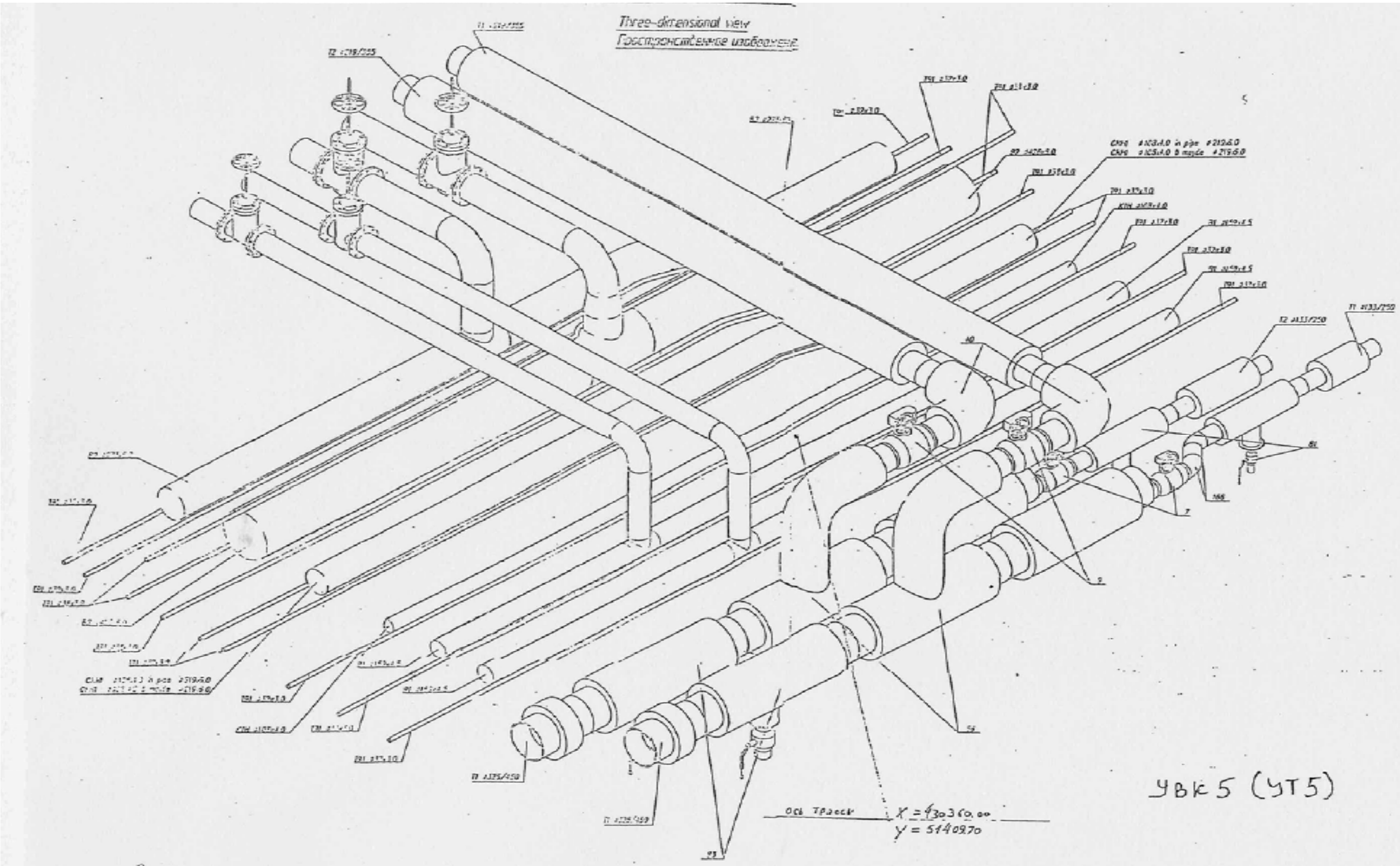


Figure A3.2-2 – Scheme of connection of household water, hot and fire water supply

A3.3 – BRIEF CHARACTERISTICS OF FACILITIES RELATIVE TO RAW HANDLING

The existing and operating equipment of ChNPP Chemical Division provides collection, evaporation of ChNPP and OS LRAW and storage of LRAW.

Capacity of special water purification facility-4 is 20 - 40 m^3/h, volume of reservoirs for LRAW storage (without accounting the reservoirs for drain waters: X02; X03; X04, 4A-204/1,2) is 34000 m^3, volume of reservoirs for LRAW storage (taking into account reservoirs X02; X03; X04, 4A-204/1,2) is 38000 m^3.

During the design of the NSC, the existing and planned RAW infrastructure will be taken into account. Description of the facilities is given below.

Liquid Radioactive Treatment Plant (LRTP)

LRTP is designed for treatment of LRAW accumulated on ChNPP industrial Site (including operational OS LRAW), that should be processed during the period of 10 years. Design operational life-time of plant is not less than 20 years. So, during subsequent 10 years, LRTP shall process LRAW, generated under works addressed to decommissioning of ChNPP units and OS conversion into ESS.

LRTP is industrial complex including as follows:

- Equipment for LRAW removal from reservoirs of LWS and SLWS;
- Equipment for preliminary treatment and reduction of LRAW volume;
- Equipment for realization the measures addressing the conditioning of waste to obtain the solidified LRAW.

Installation of deep evaporation till salt content of 650 g/l will be used to realize preliminary treatment of vat residue with slimes.

Hydro-transport waters with pulp of filter materials will be hand over to separator, where resins and pulp of perlite will be separated against of hydro-transport waters and directed to the plant of cementation.

To obtain final treatment of vat residue concentrated product with slimes, ion-changed resins and the perlite pulp, the plant of cementation will be applied.

Spent oils and organic solvents, allocated in reservoirs for LRAW storage, are not subjected to be processed; they will be separated from water constituent temporary storage in LRTP with further transportation to the combustion plant, consisting of SWPF.

Final product (solidified LRAW in 200-l drums) are subjected the handing over for disposal in ENSDF, consisting of ICSRM.

Design capacity of LRTP is 2500 m^3/year of non-treated (source) LRAW. Output of final product (200-l drums) at round-the-clock mode of operation is 42 drums per day. Total number of 200-l drums, required for packing the solidified LRAW, received after processing of liquid waste, storing in the LWS и LSWSF, is assessed in about 100000. Buffer internal plant-site is designed for temporary storage of 294 drums (during 7 interruptible operational mode of plant).

Industrial Complex for Solid Radwaste Management (ICSRM)

ICSRM is designed for removal and processing/conditioning of:

- solid waste accumulated during all ChNPP operational time ;
- operational SRW from Power Units and OS;
- SRW, generated during progress of decommissioning.

ICSRM consists of three Lots:

- Lot 1: Retrieval Facility for Solid Waste (RFSW);
- Lot 2: Solid Waste Processing Facility (SWPF);
- Lot 3: Engineered Near-Surface Disposal Facility for low-and-intermediate-level short-lived radioactive waste (ENSDF).

RFSW is designed to extract SRW from SWS and its loading into transport containers to transfer them into SWPF. All the SRW being under storage in SWS: LIL-SLW, LIL-LLW and HLW are subjected to be extracted. Design capacity of RFSW should constitute not less than 3 m^3 of waste per day.

SWPF is designed for sorting/ segregation of all SRW categories and processing of LIL-SLW, generated during implementation of work on RAW removal (RFSW), as well as operational waste and waste generated after ChNPP decommissioning. Calculated operational life-time of SWPF is 30 years.

Design output of the SWPF is about 20 m^3 of non-treated waste per a day (3500 m^3 per a year). Capacity of plant for SRW combustion is 50 kg/h, as to burning of LRAW (lubricating and turbine oils), it is 10 kg/h. Square of buffer storage of final product should be sufficient to store the product output obtained for seven days of plant interrupted operation. Taking into account an operation experience of similar plants, capacity of SWPF mud room should be about 10 m^3 per day (1750 m^3 per year).

Capacity of area for LIL-LLW and HLW outside packages should be about 1.5 m^3 of non-treated waste per a day, and volume of temporary storage facility in LSWSF – not less than 3500 m^3.

LIL-SLW will pass through the procedures of packing and immobilization for subsequent disposal into ENSDF, but waste classified as LIL-LLW and HLW, will be packed and transfer into temporary storage facility for LIL-LLW and HLW for storage.

Temporary storage facility for LIL-LLW and HLW is designed for temporary storage of solid LIL-LLW from SWPF, as well as for storage of HLW from SWPF and OS. Operational life-time of temporary storage is 30 years. Volume of waste accepted for storage in drums of 200-l constitutes ~ 13000 drums (with drums of 165-l of volume, which are packed inside them).

ENSDF is designed for near surface disposal of LIL-SLW. Waste will be accepted for disposal in packages, solidified in cement matrix. Design life-time of fencing structures is 300 years. All equipment being under operation at the filling-in stage (till completion the work addressed to preservation of storage-facility), should be operated during operational period equal to 30 years. Volume of packed SRW should be 50200 m^3.

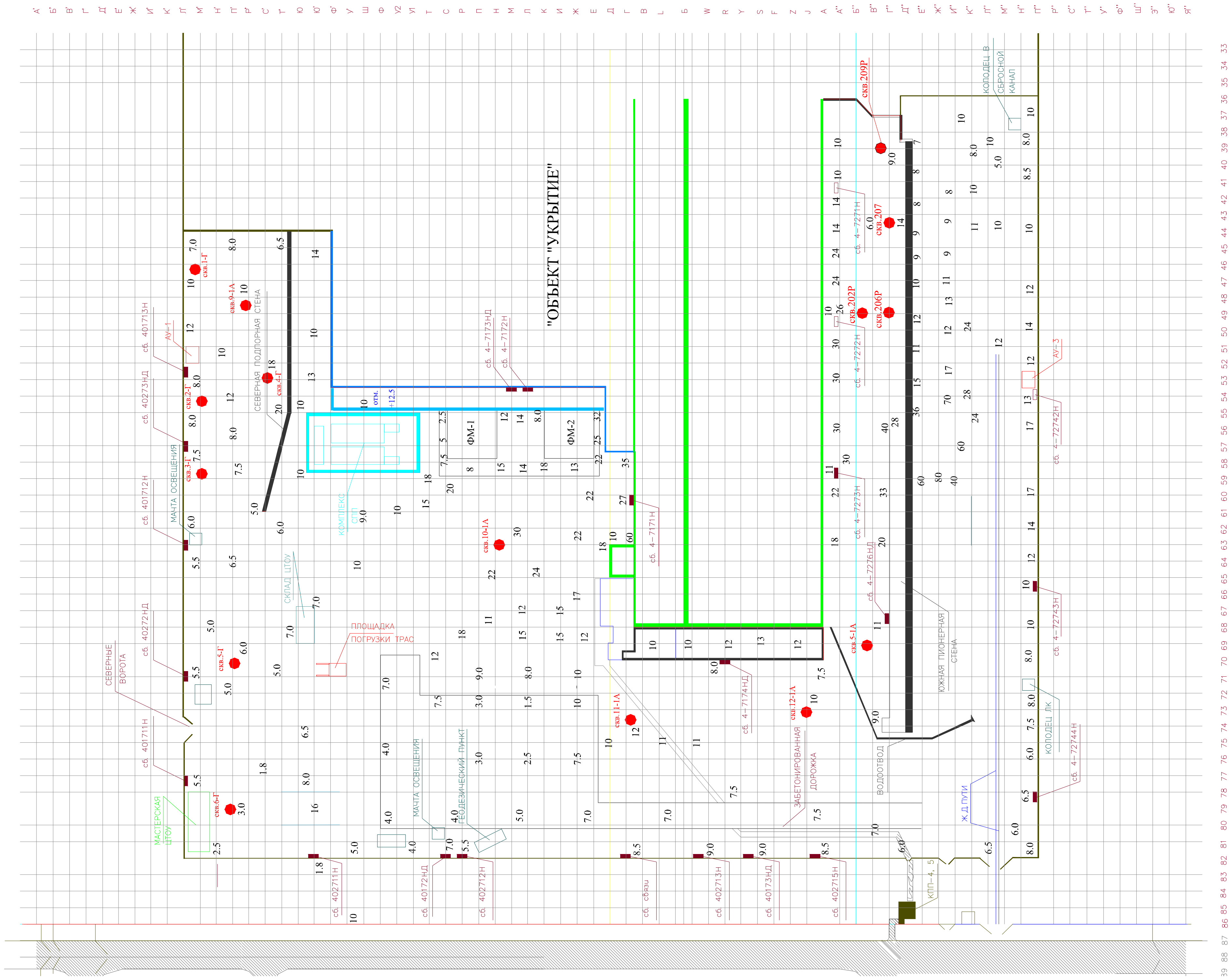
Storage facility of the OS LIL SL SRW (planned for construction and commissioning after filling of ENSDF) will be designed for disposal of SSE ChNPP SL LIL SRW including the OS.

Temporary storage facility of HLW and LLW SRW (planned for construction and commissioning after filling of LIL-LLW and HLW into LSWSF) will be designed for acceptance and temporary storage of conditioned HL and LL SRW.

High-level Waste Interim Storage Facility (HLWISF)

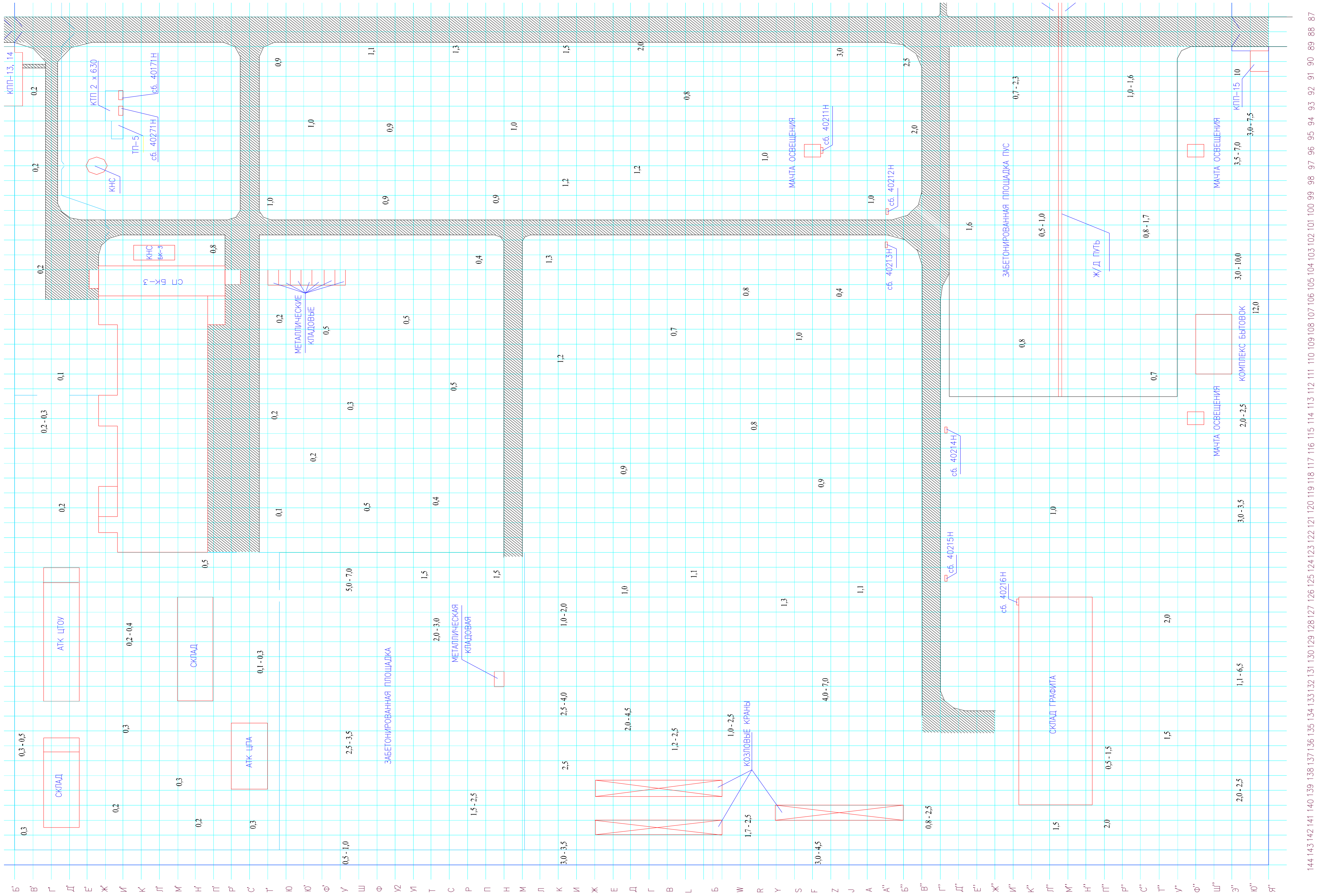
HLWISF is provided in Room 12/2 of Building 12, and it ensures storage of HLW for the period prior to commissioning of interim storage facility for LMLW-LL and HLW as part of ICSRM. HLWISF has the capability of storing up to 16 m^3 of HLW. The waste is stored in containers КТЗВ-0,2 (80 containers). There is possibility of increasing the capacity of HLW storage to 36 m^3 (total of 180 containers КТЗВ-0.2).

A3.4 - CARTOGRAMS OF GAMMA DOSE RATES IN LOCAL AREA AND SHELTER SITE



EDR values are provided in mR/h

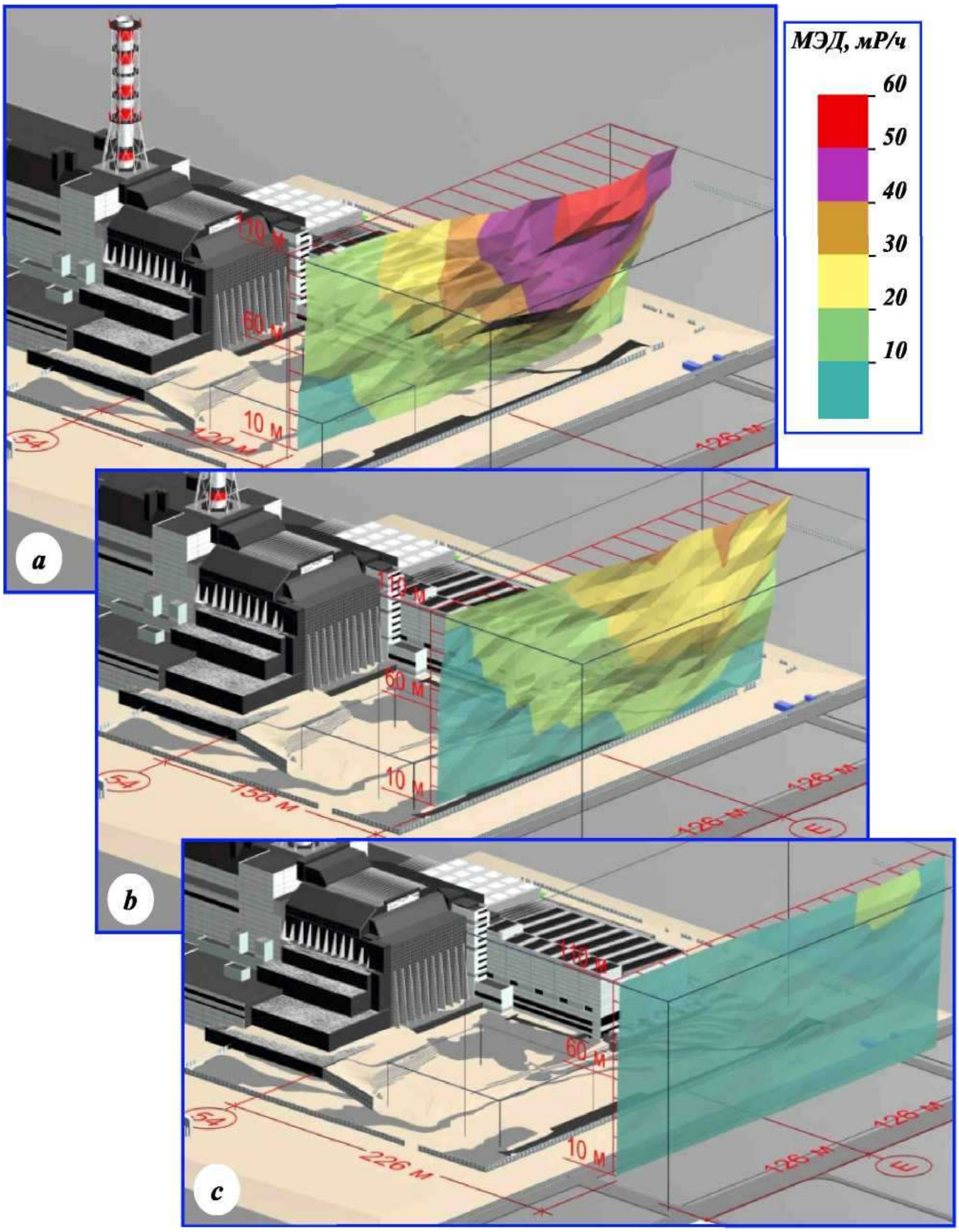
Figure A3.4-1 – Cartogram of Local Area OS (2008)



EDR values are provided in mR/h

Figure A3.4-2 – Industrial Site Cartogram OS (2008)

a3.5 – Results of pre-project investigations of NSC building area



a – section at axis 54+ 120 m; в - section at axis 54+ 156 m; c - section at axis 54 + 226 m

Figure A3.5-1 – γ-Field Model in Dimension-1

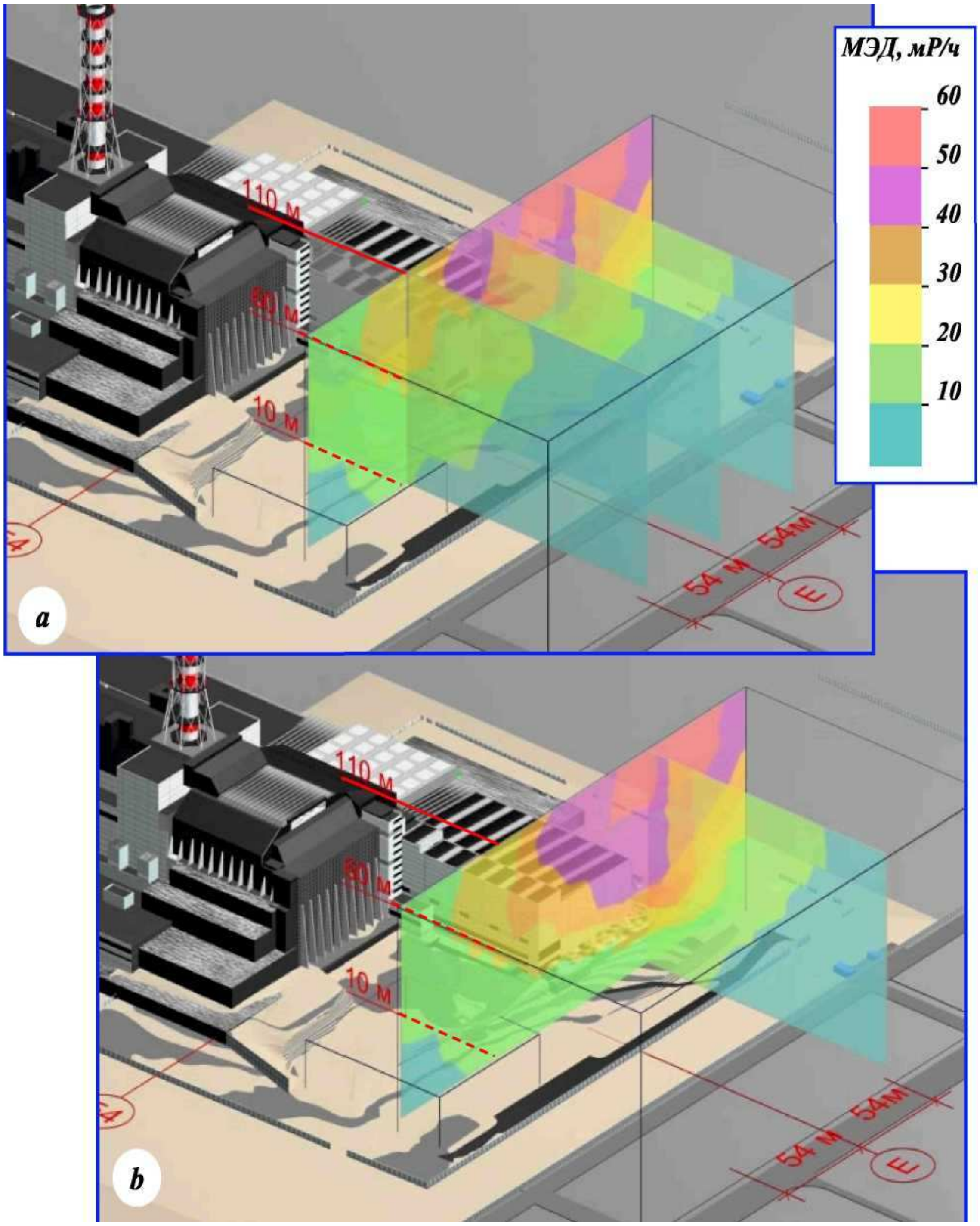


Figure A3.5-2 – γ-Radiation Dose Rate Distribution on NSC Construction Site

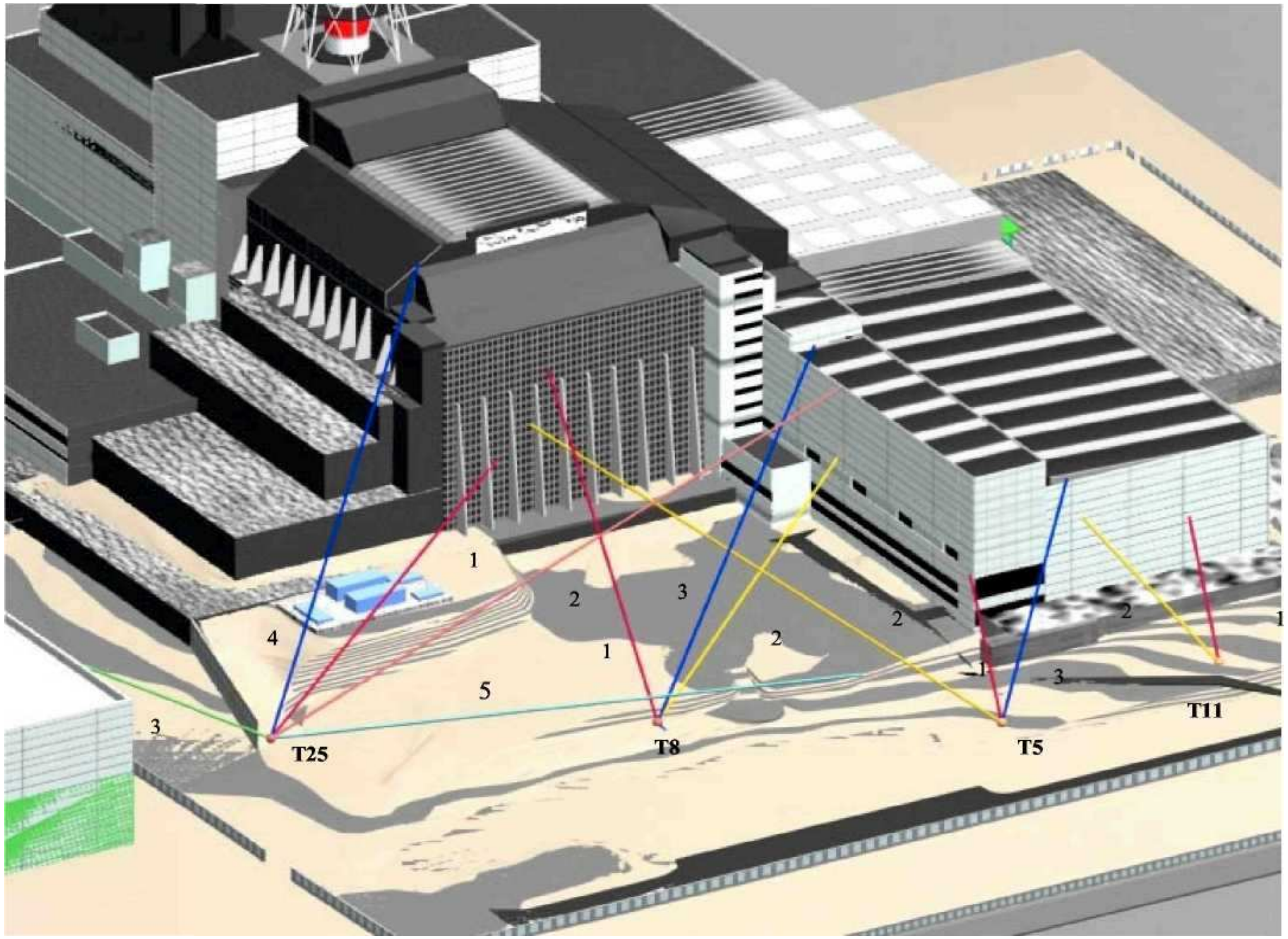


Figure A3.5-3 – Angle γ-radiation Directions Contributing to Dose Rate at Measurement Points T-5, T-8, T-11 and T-25

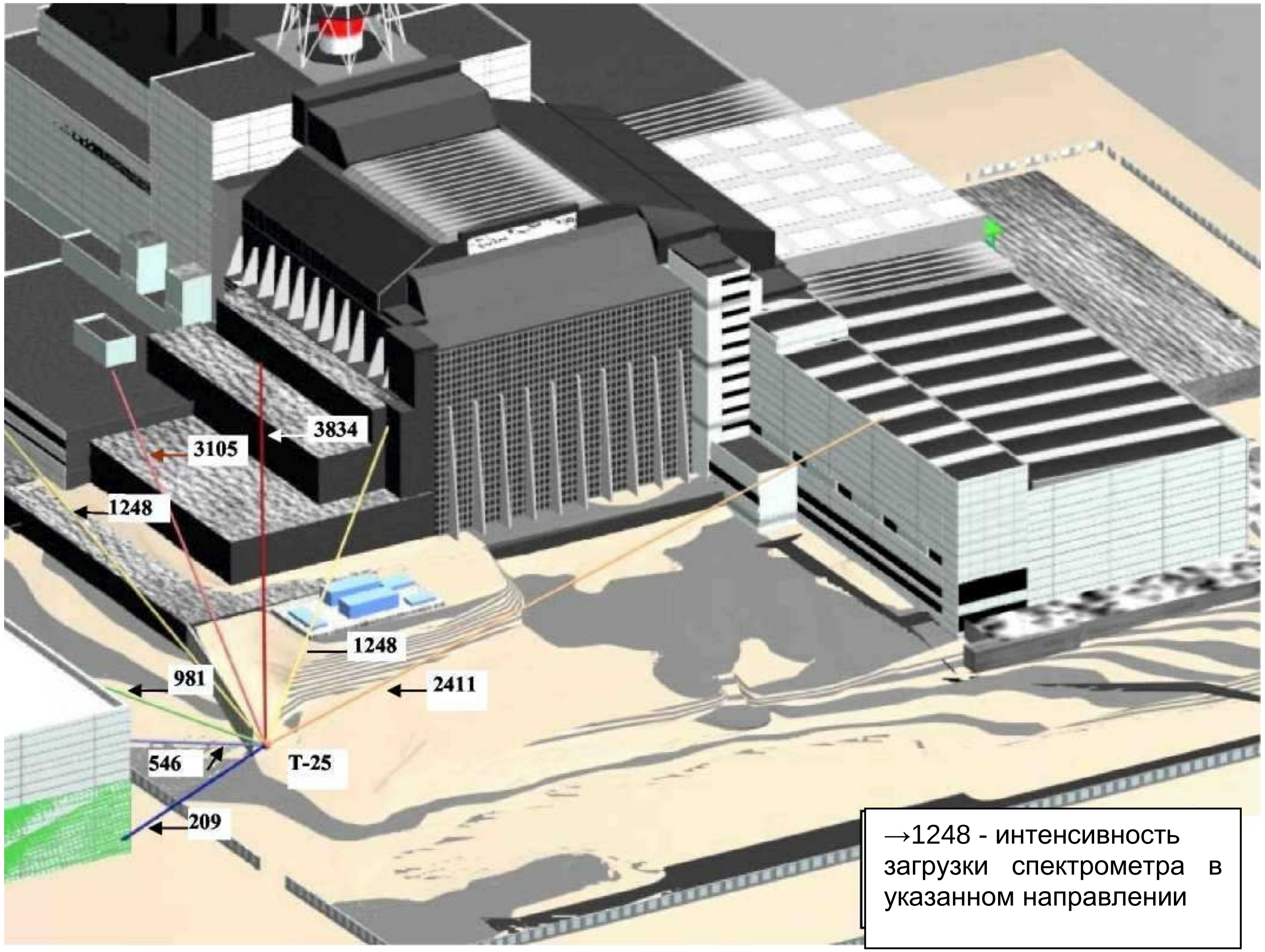


Figure A3.5-4 – Angle γ–Radiation Directions Contributing to Dose Rate at Measurement Point T-25

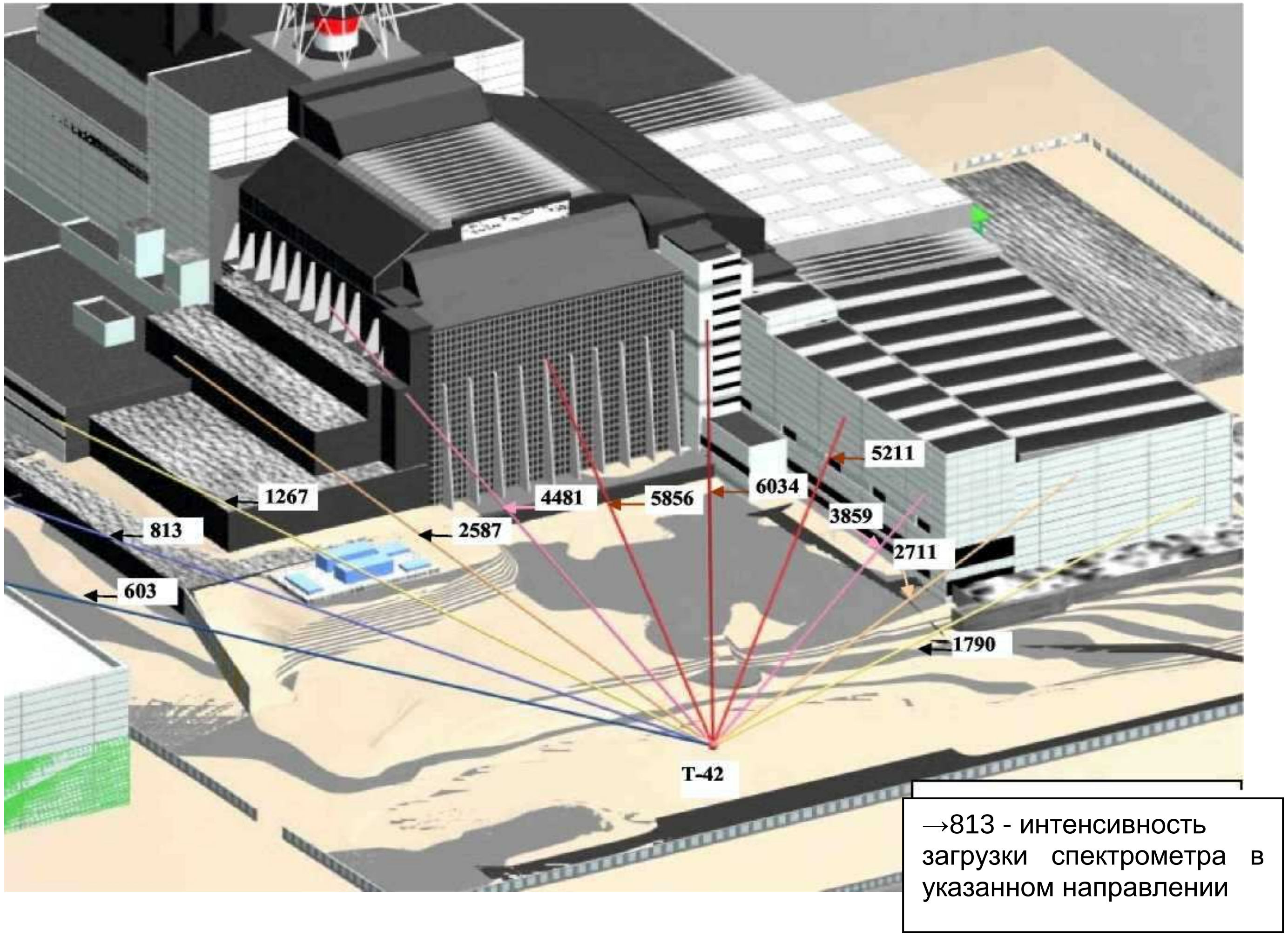


Figure A3.5-5 – Angle γ–Radiation Directions Contributing to Dose Rate at Measurement Point T-42

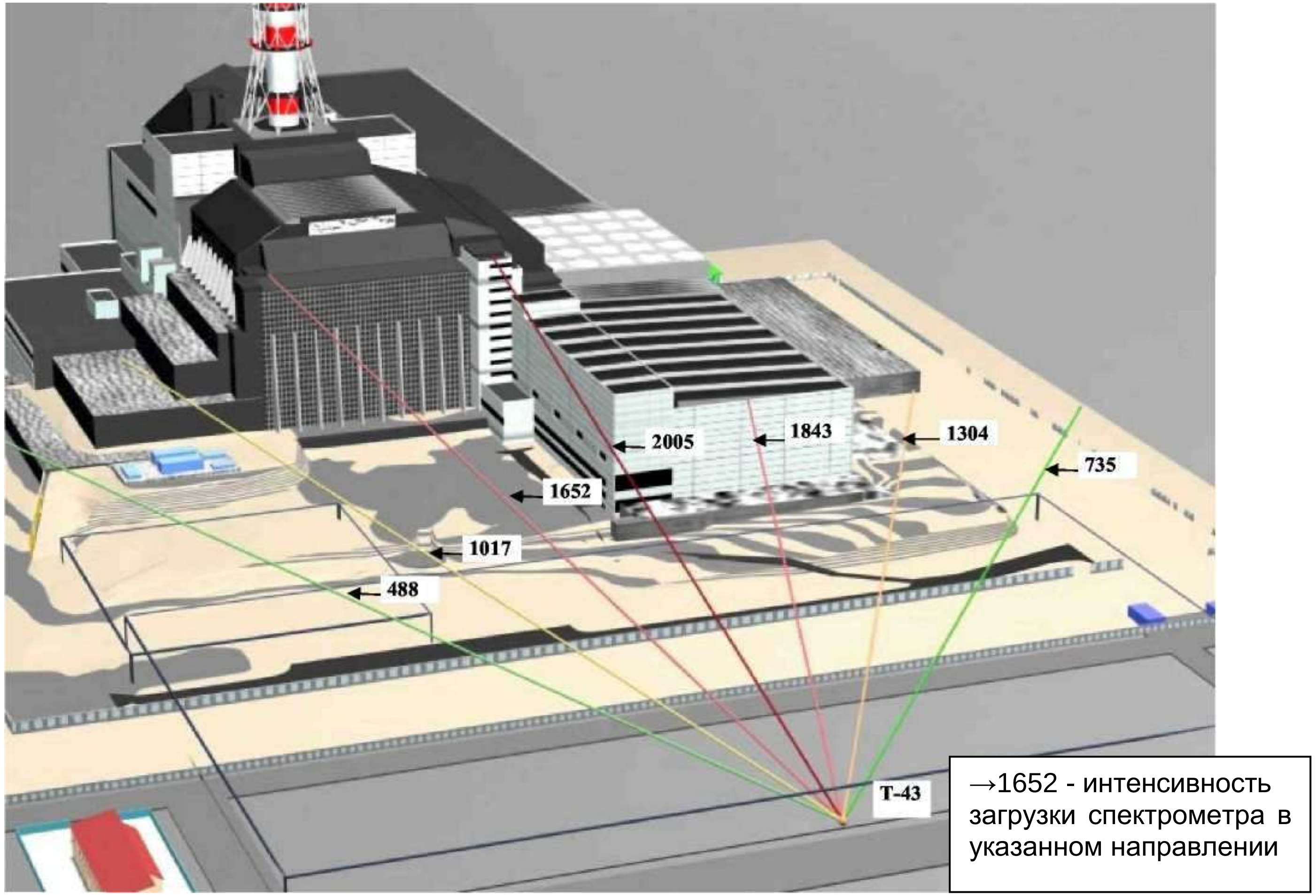


Figure A3.5-6 – Angle γ–Radiation Directions Contributing to Dose Rate at Measurement Point T-43

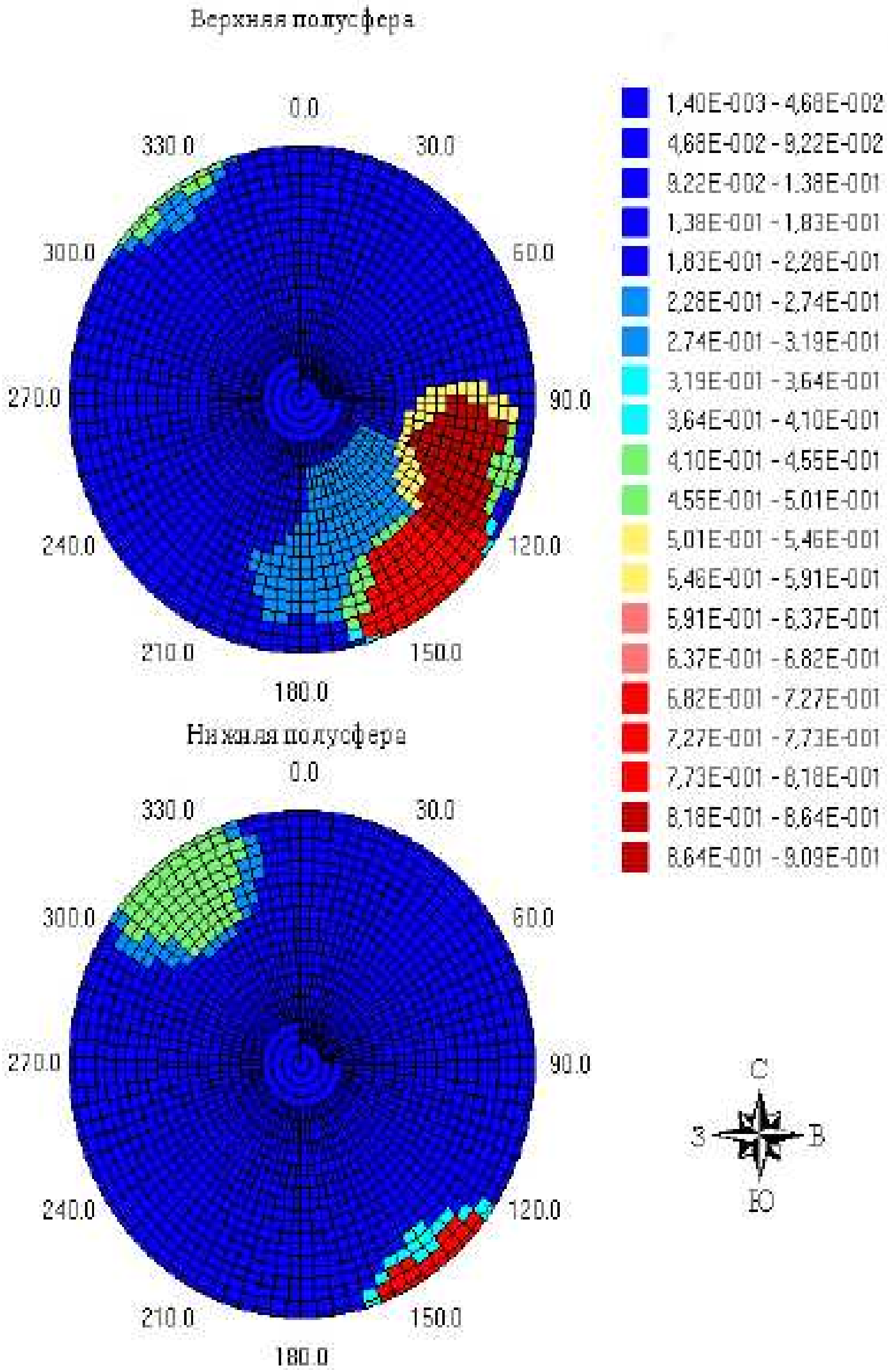


Figure A3.5-7 – Maps of Angle Intensity Distribution of γ–Radiation at Height of 1 m at Point 35, μR/h·sr

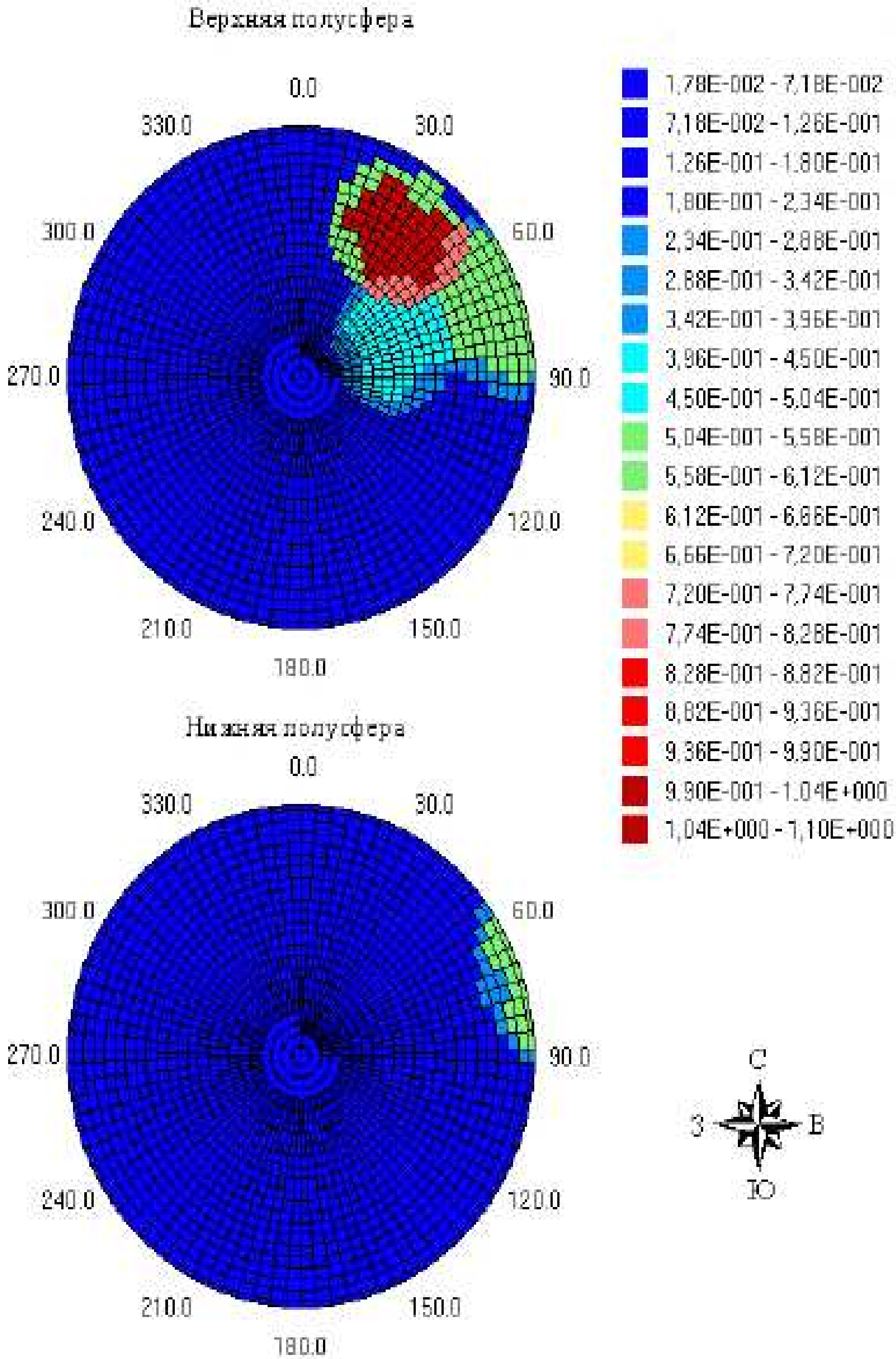


Figure A3.5-8 – Maps of Angle Intensity Distribution of γ–Radiation at Height of 1 m at Point 41, μR/h·sr

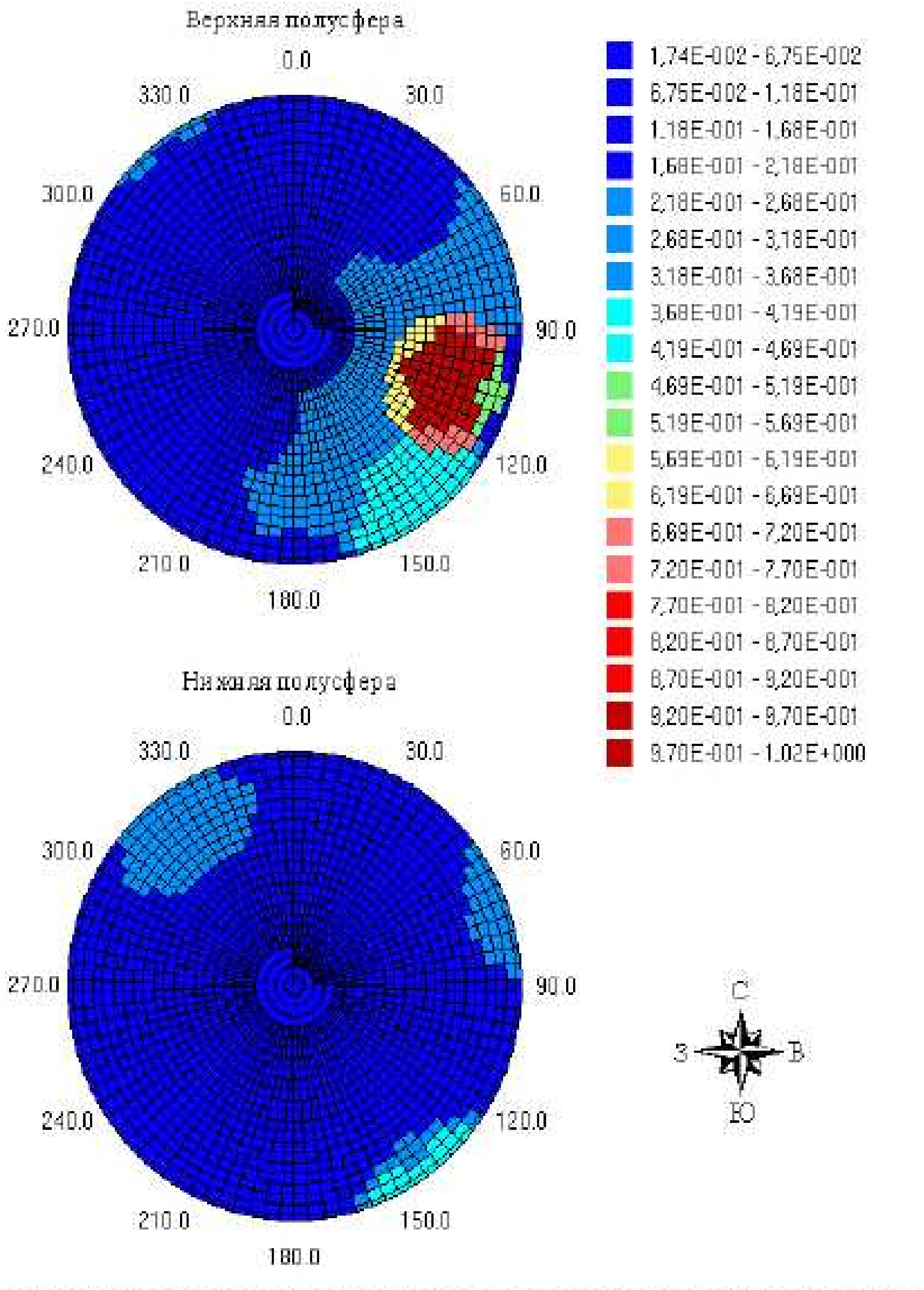


Figure A3.5-9 – Maps of Angle Intensity Distribution of γ–Radiation at Height of 1 m at Point 42, μR/h·sr

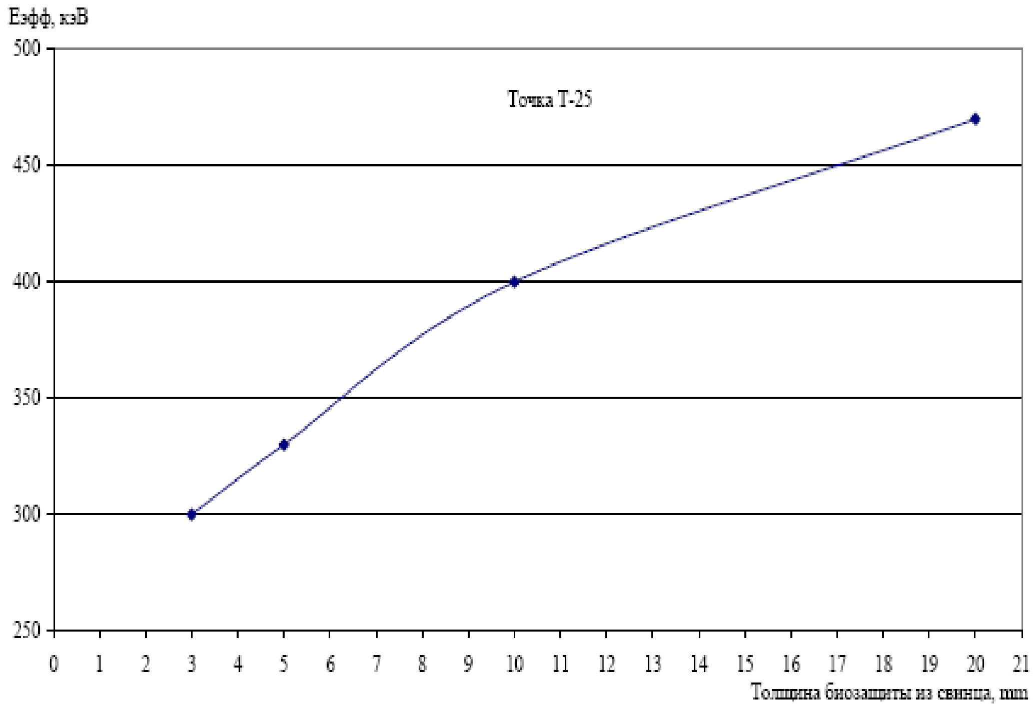


Figure A3.5-10 – Dependence of γ–Radiation Effective Energy on Lead Thickness

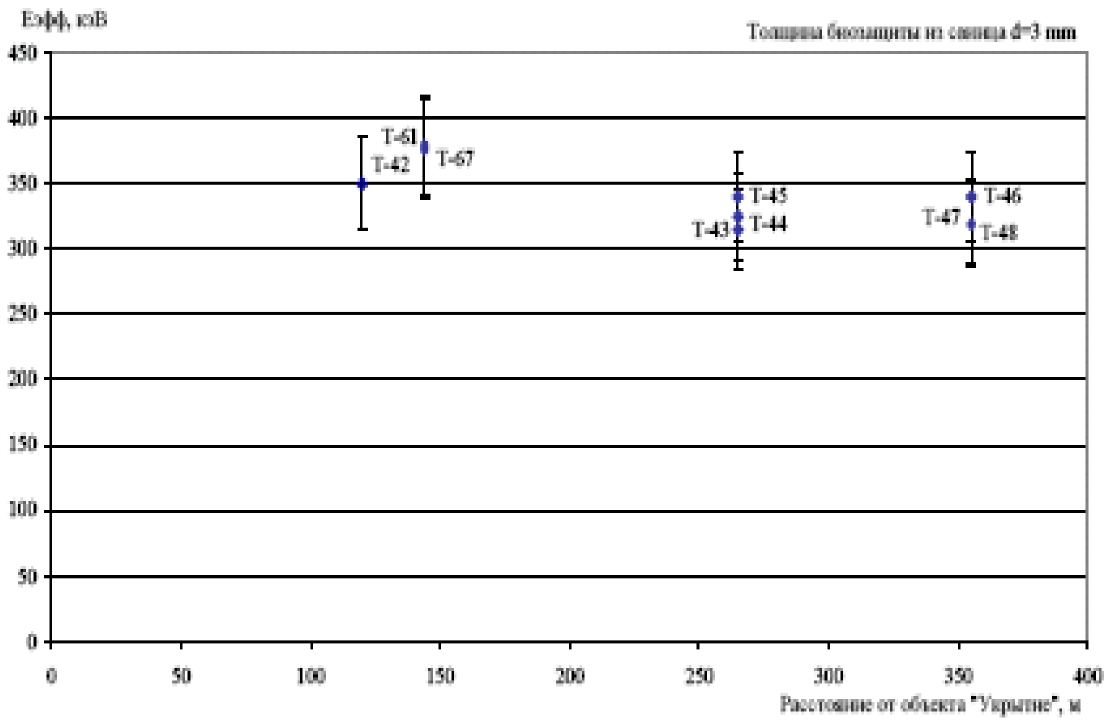


Figure A3.5-11 – Dependence of γ–Radiation Effective Energy on Distance to Shelter for Lead Shielding of 3 mm in Diameter

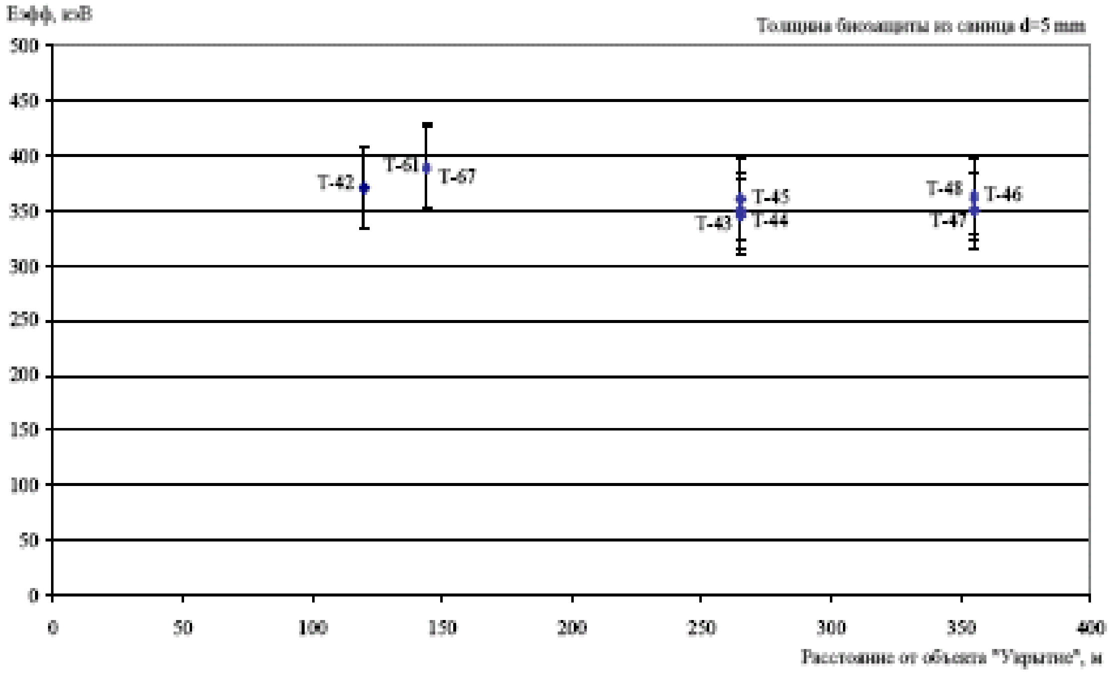


Figure A3.5-12 – Dependence of γ–Radiation Effective Energy of Distance to Shelter for Lead Shielding of 5 mm in Diameter

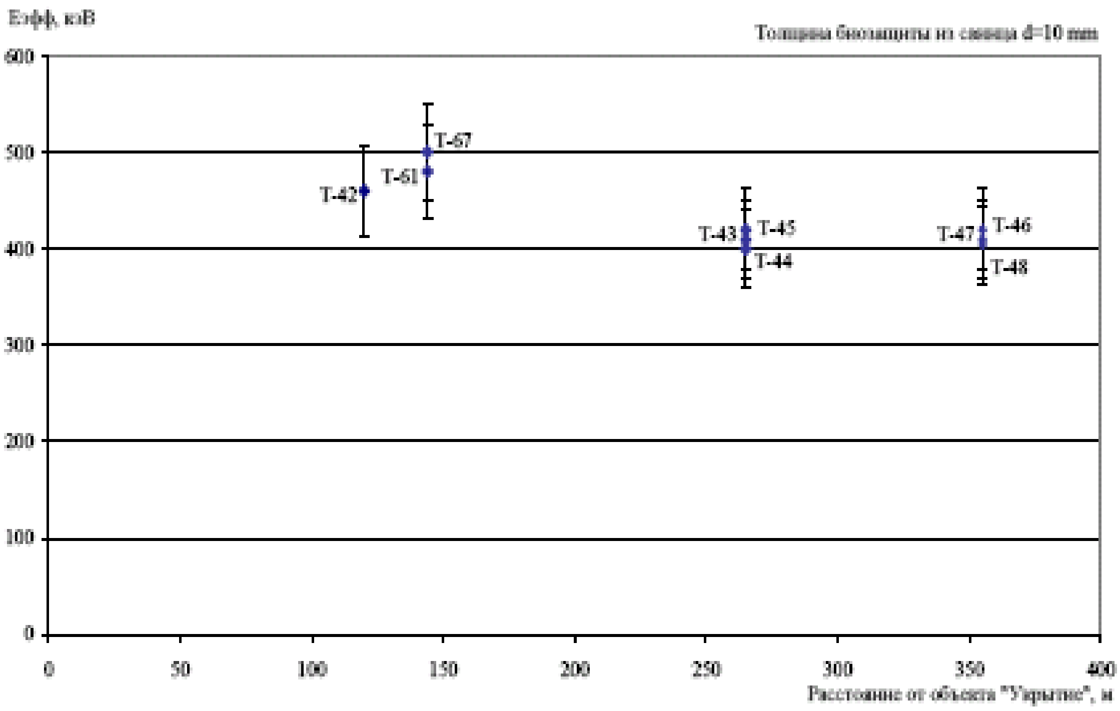


Figure A3.5-13 – Dependence of γ–radiation Effective Energy of Distance to Shelter for Lead Shielding of 10 mm in Diameter

A3.6 - SKETCHES AND DIAGRAMS OF THE OS BUILDING STRUCTURES

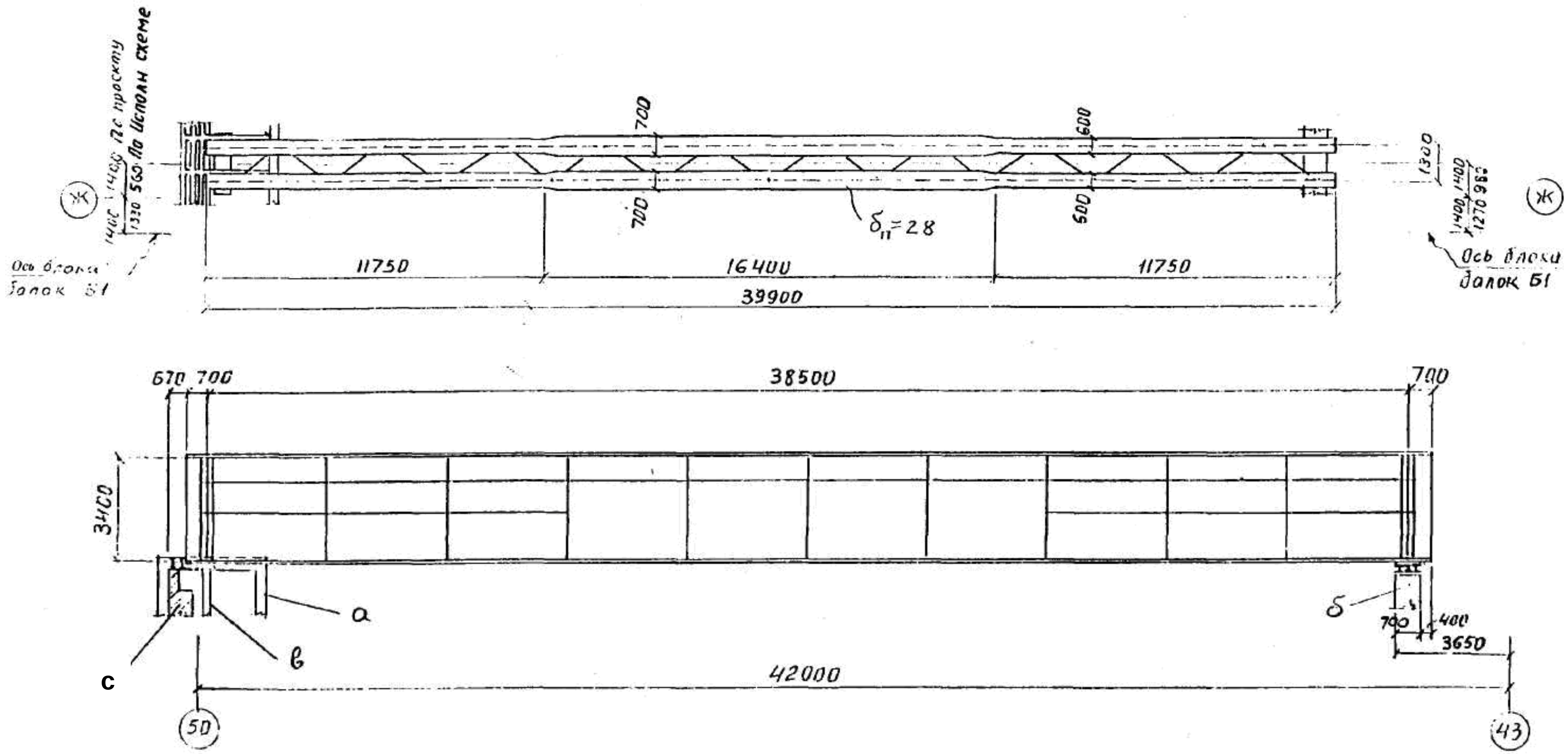


Figure A3.6-1 – Constructive diagram of beam B2 (near Row Ж)

a - metal casing; b – wall of ventilation shaft near axis 43; c – additional support racks; d – wall near axis 50

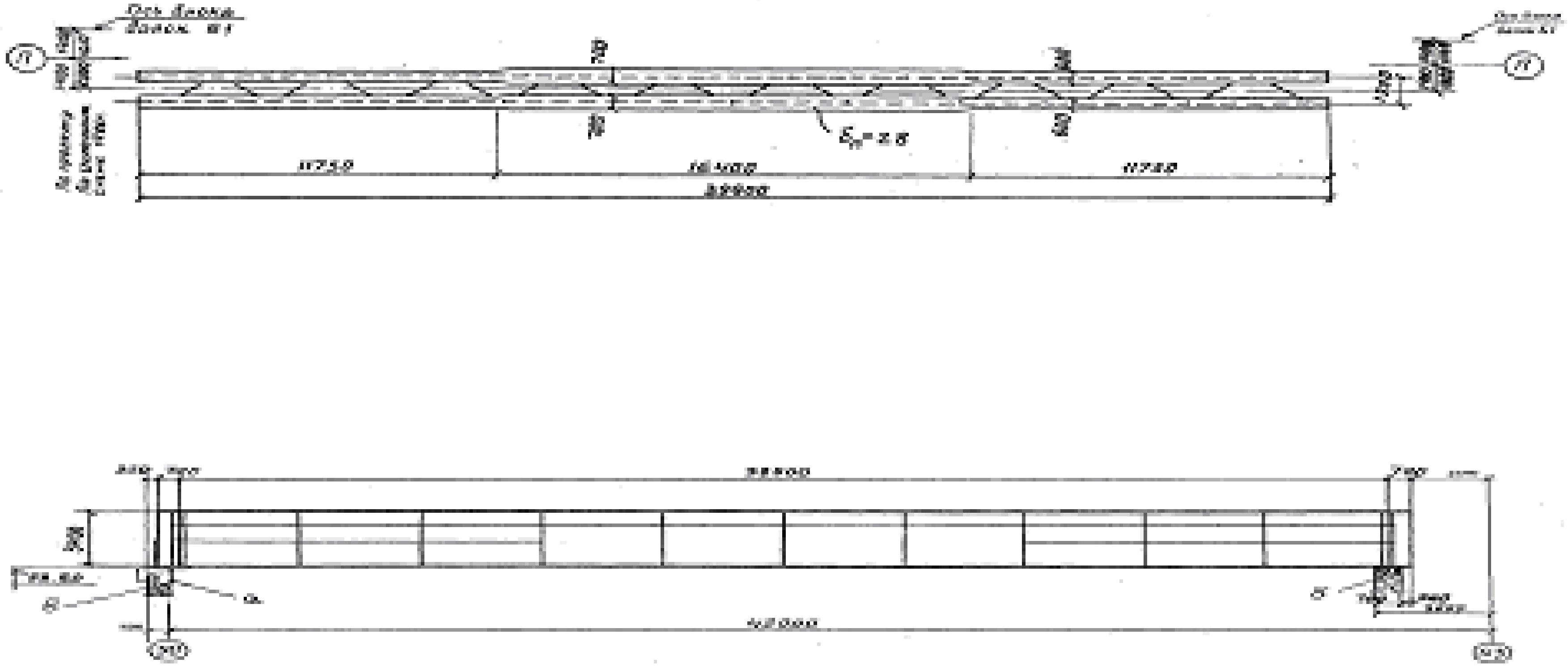


Figure A3.6-2 – Constructive diagram of beam B2 (near Row П)

a – supporting element; b – wall of ventilation shaft near axis 43; c – wall near axis 50

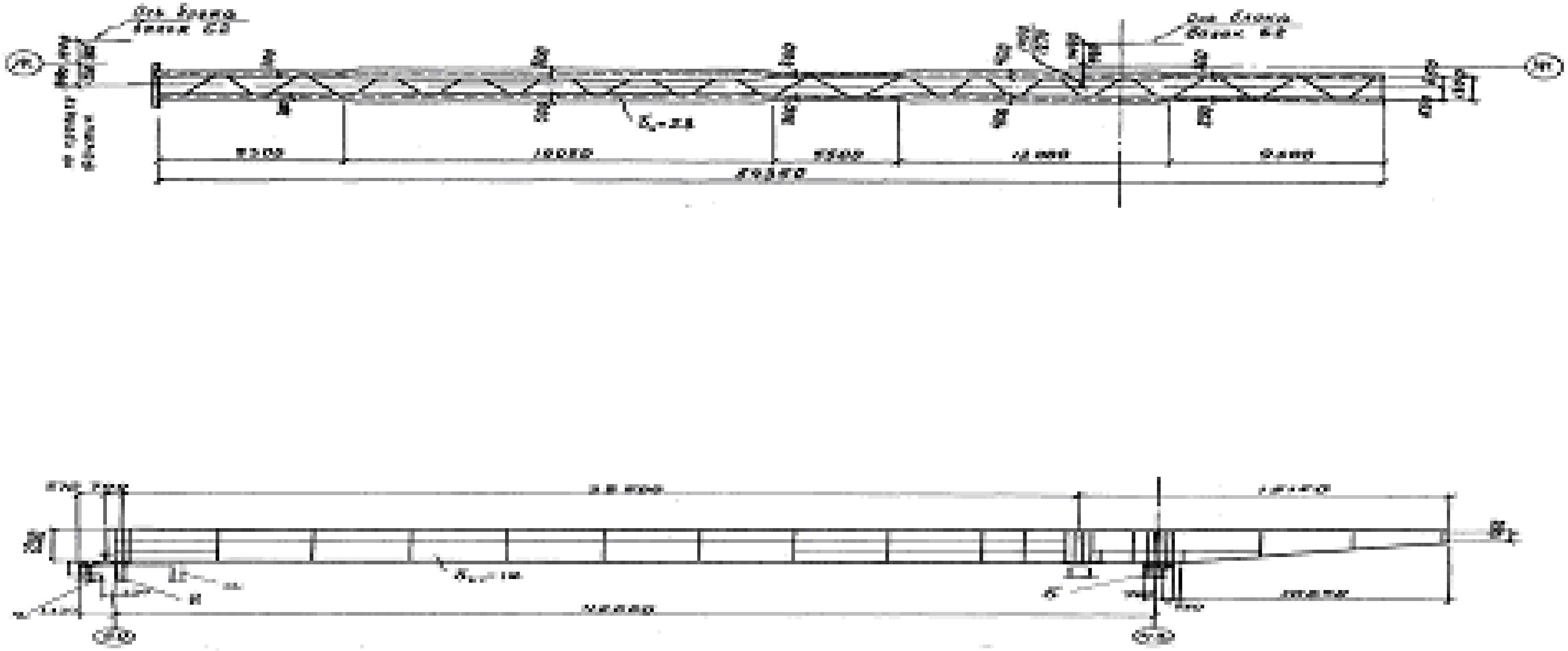


Figure A3.6-3 – Constructive diagram of beam B1 (near Row Ж)

a - metal casing; b – ventilation shaft wall along axis 43;

c – additional support racks; d – wall near axis 50

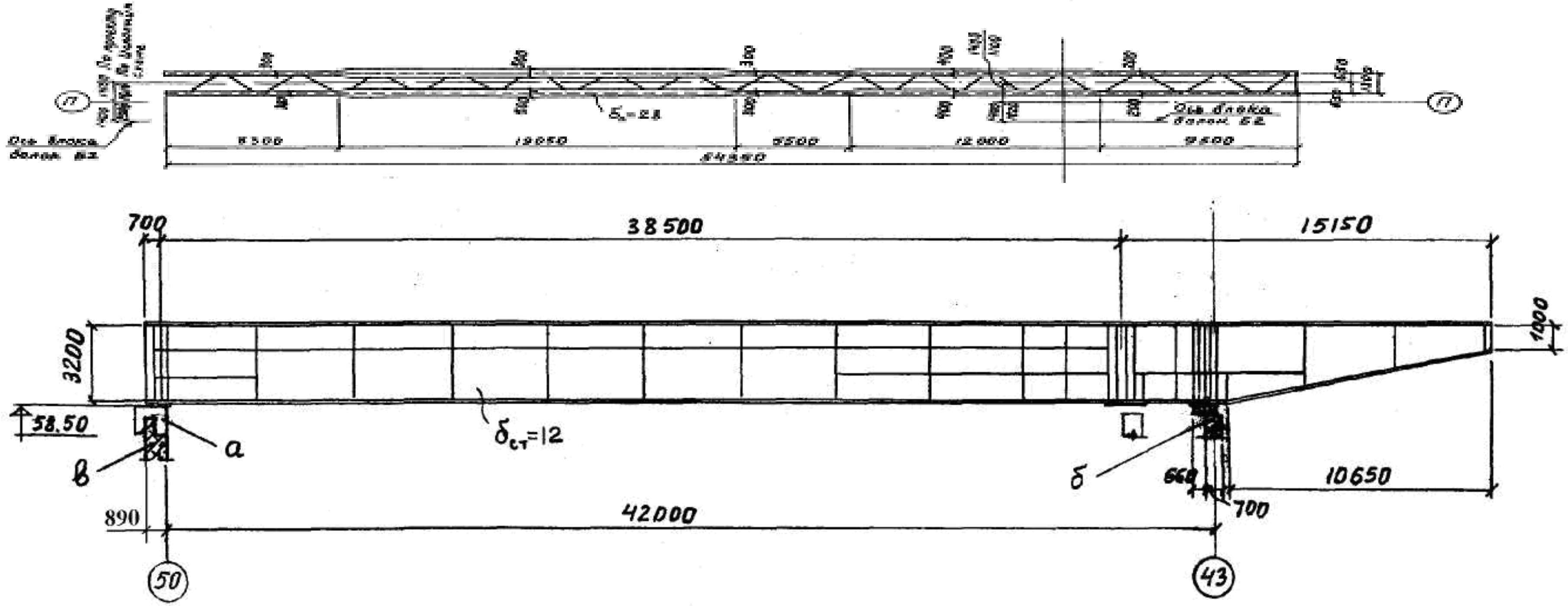


Figure A3.6-4 – Constructive diagram of beam Б1 (near Row П)

a – supporting element; b – ventilation shaft wall along axis 43; c – wall along axis 50

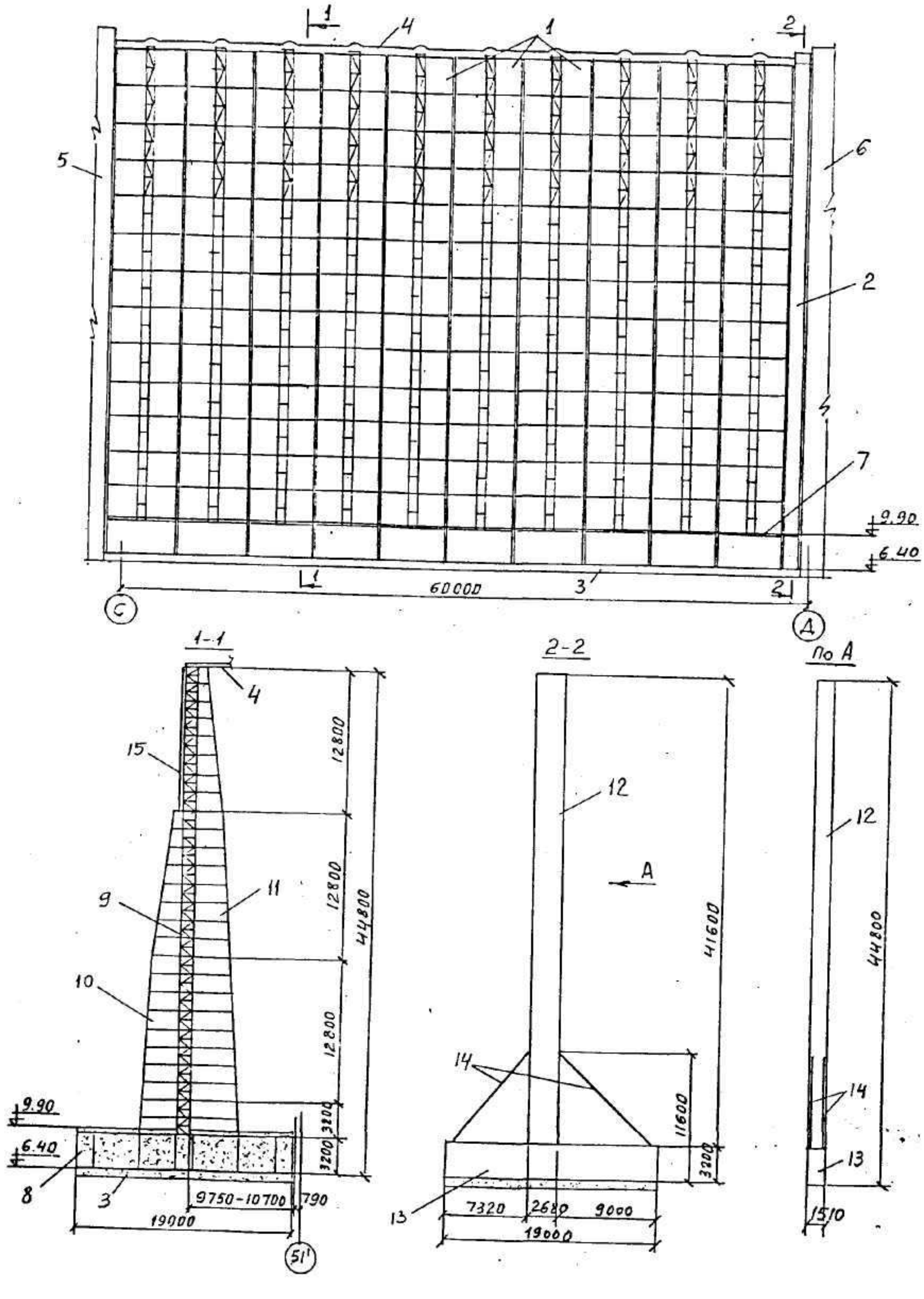


Figure A3.6-5 – Western buttress wall

1 – mounting sections S-50, 2 - additional block, 3 – concrete support,
4 – roofing, 5 – protective tower, 6 – Turbine Hall wall,
7 – rubble concrete filling 8 – foundation of section, 9 - wall (shield),
10 -front buttress, 11 – back buttress,
12 – shield part of additional block, 13 – foundation of additional block,
14 – backstays of channel No 20, 15 – mounting frame

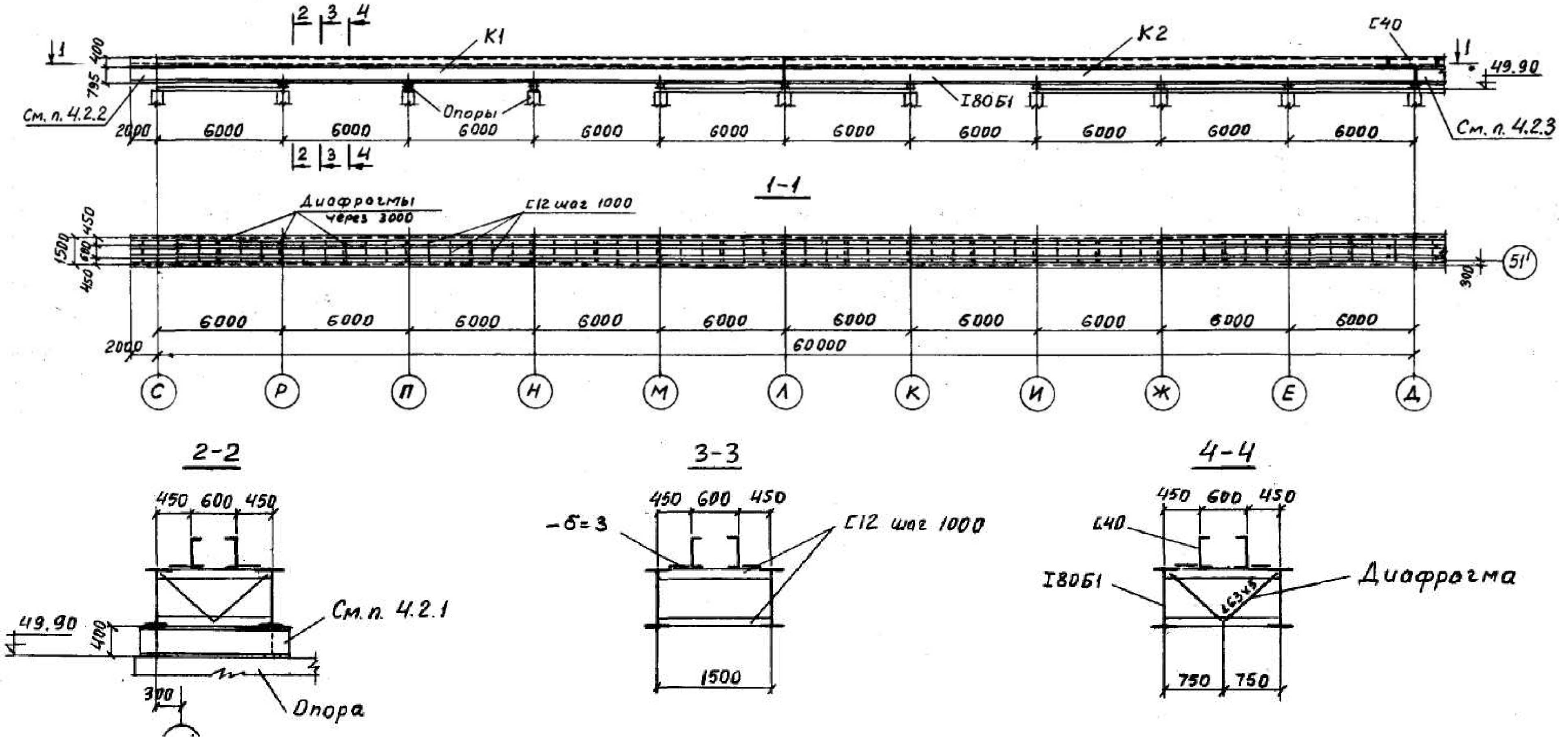


Figure A3.6-6 – Boxes – beams К1И, К2И

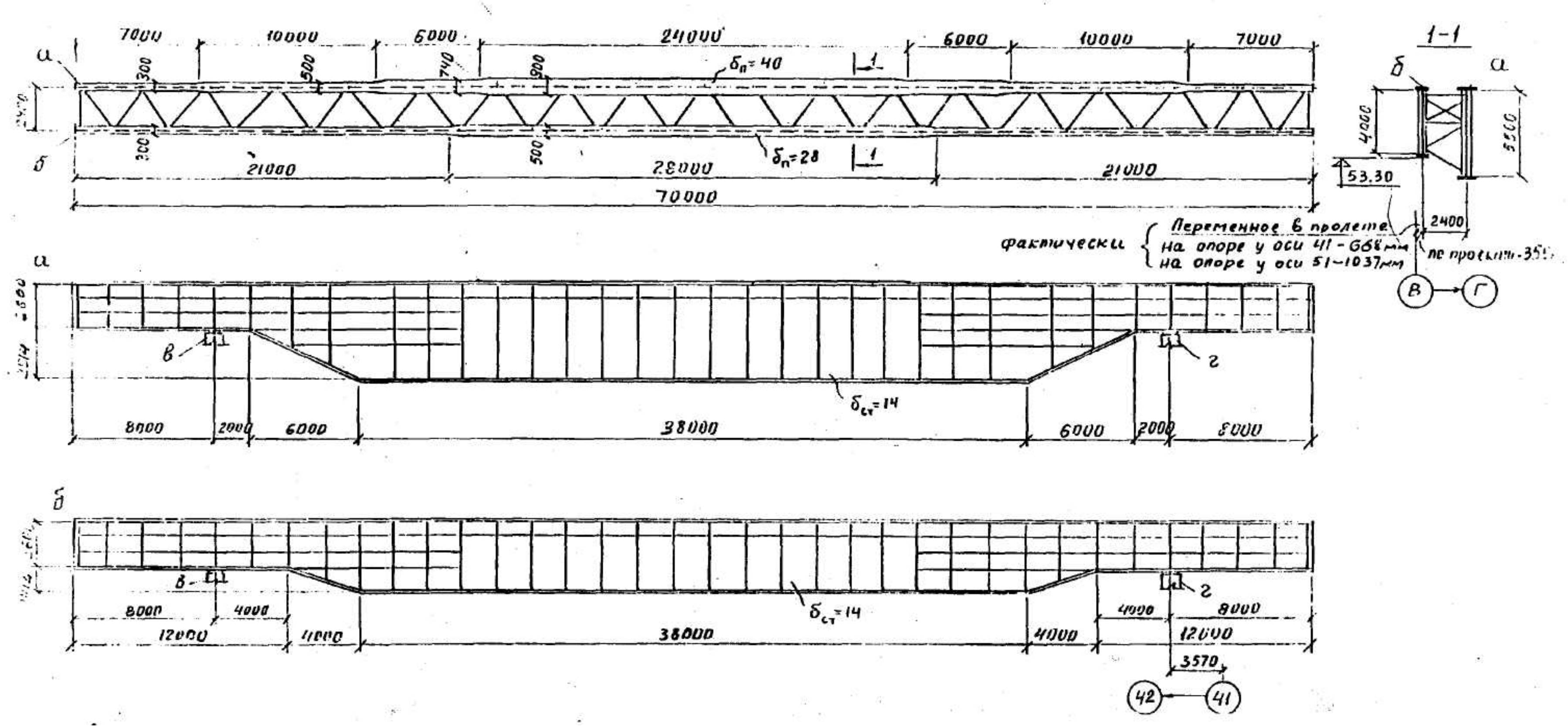


Figure A3.6-7 – Constructive diagram of beam «Mammoth»

a) western beam (large), b) front beam (small), c) western support near axis 51 (grill metal-ware), d) – support near axis 41 (concrete pedestal)

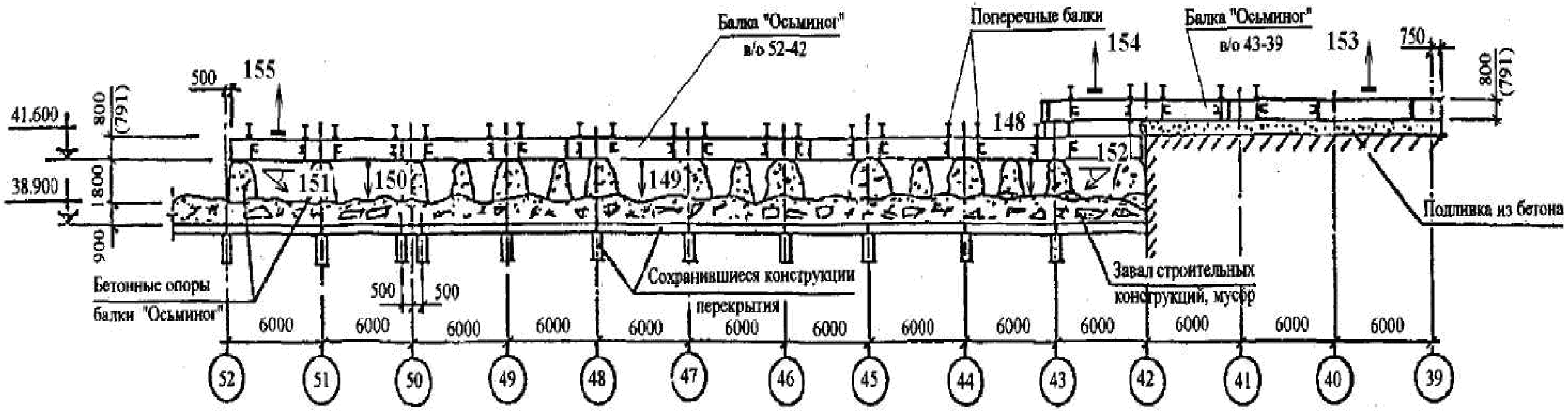


Figure A3.6-8 – Beam «Octopus» along Row Б in axes 39-52

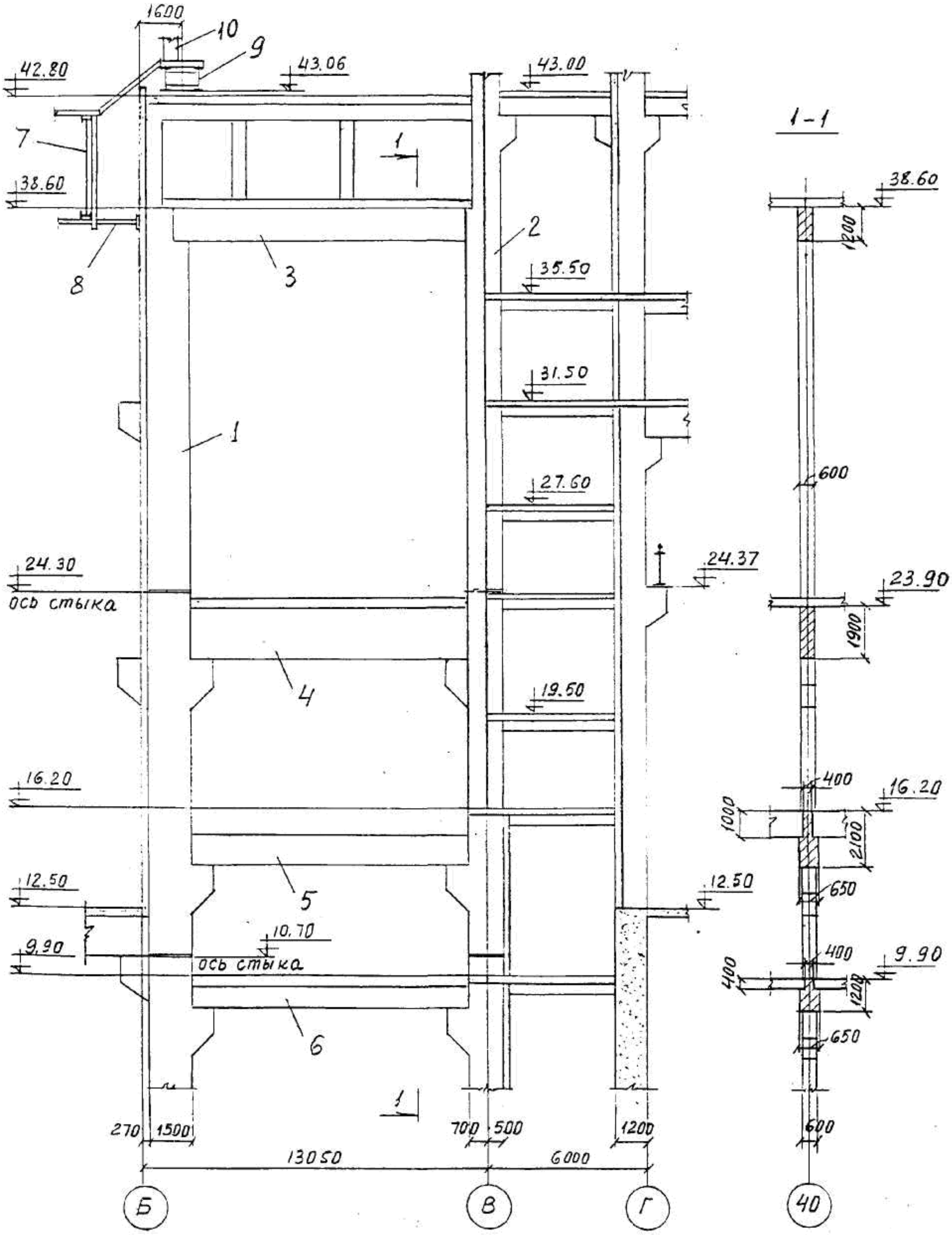


Figure A3.6-9 – Frame of Deaerator Rack casing along axis 40

1, 2 – columns along row Б and В; 3, 6 - collars; 7 – Turbine Hall covering frame; 8 -support; 9 -beam «Octopus»; 10 - «hockey-stick»

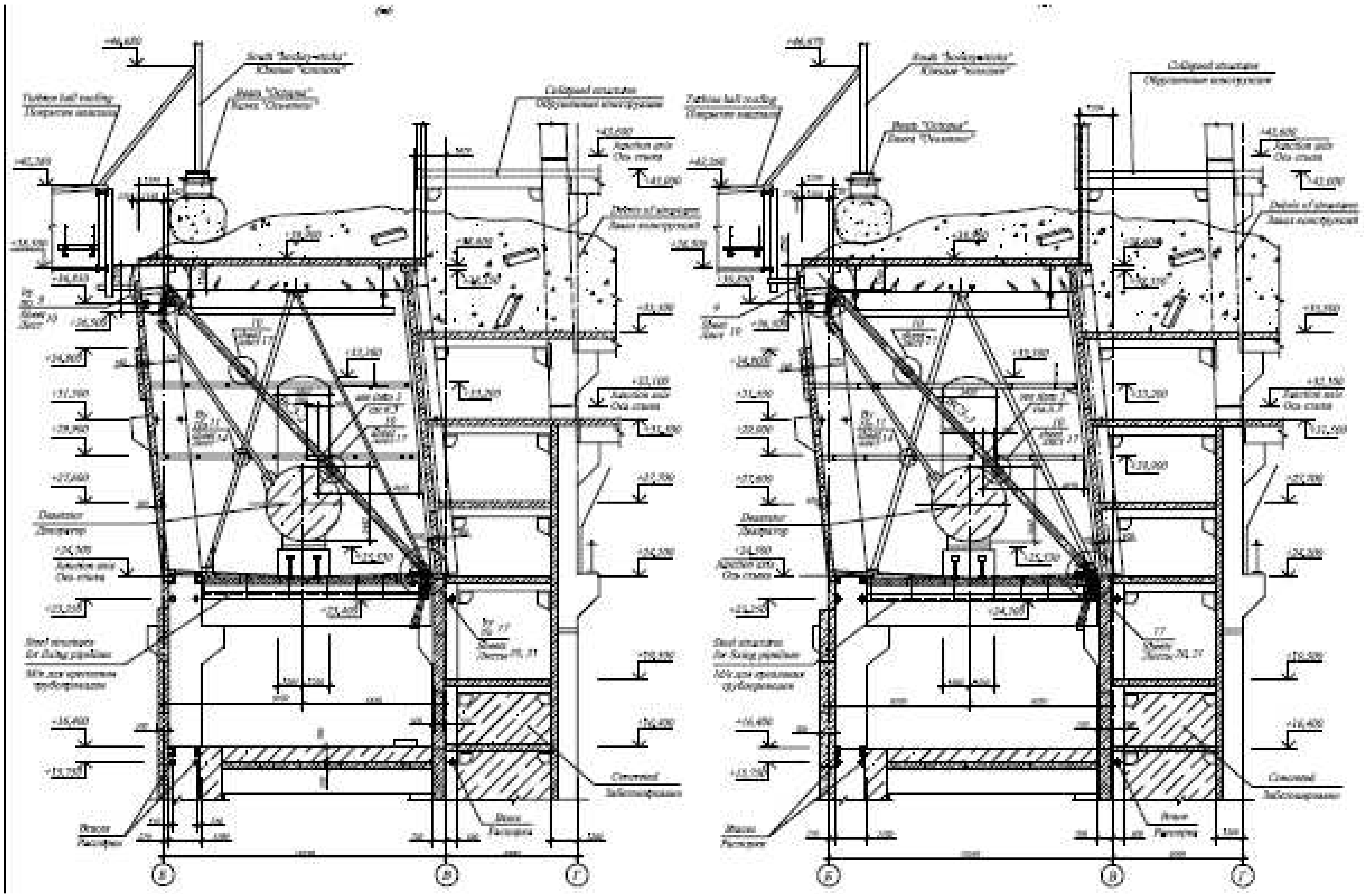


Figure A3.6-10 – Deaerator Rack casing along axes 43-47

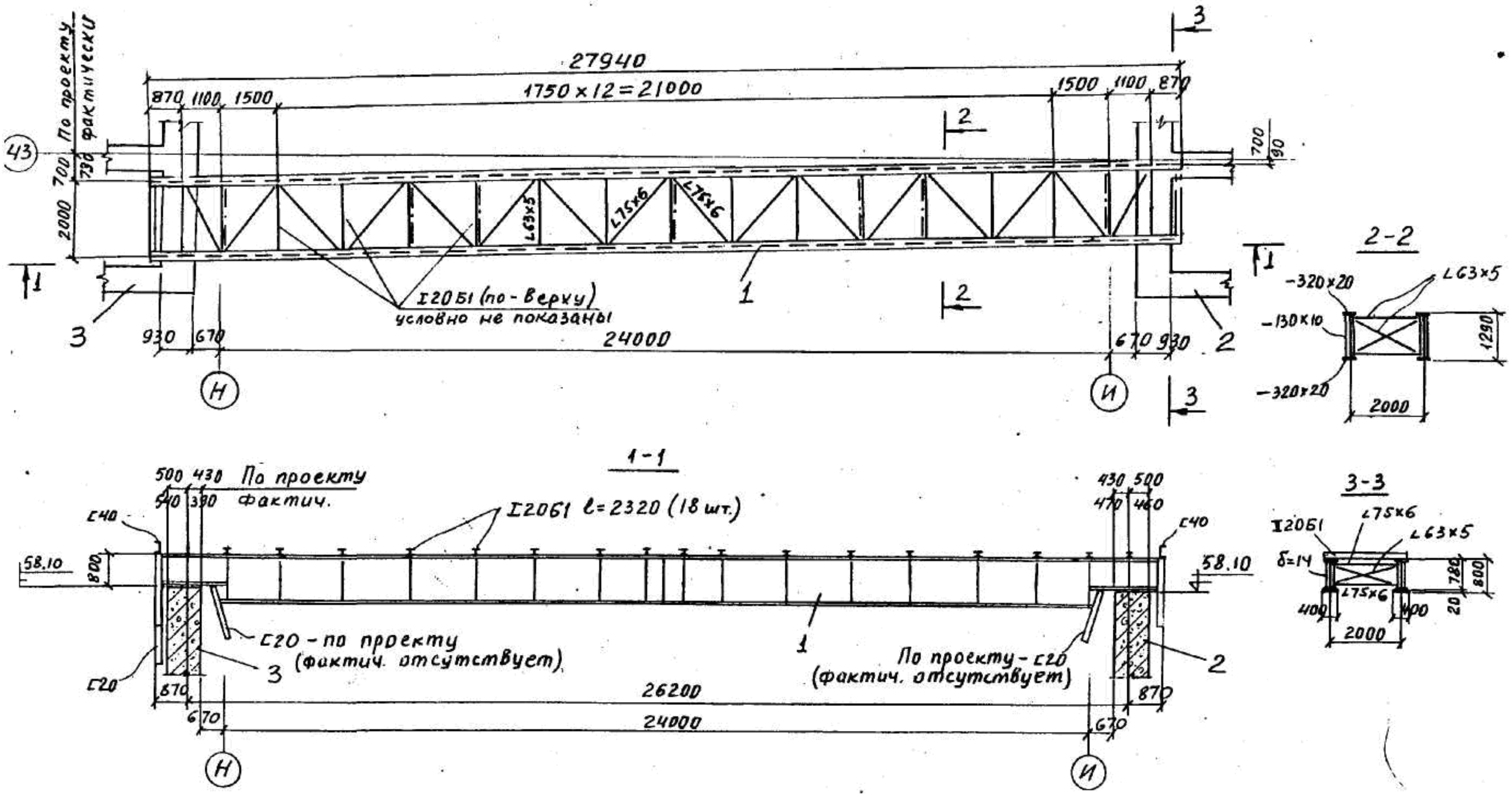


Figure A3.6-11 – Diagram of beam Б5

1 - beam Б5; 2 – southern ventilation shaft; 3 – northern ventilation shaft

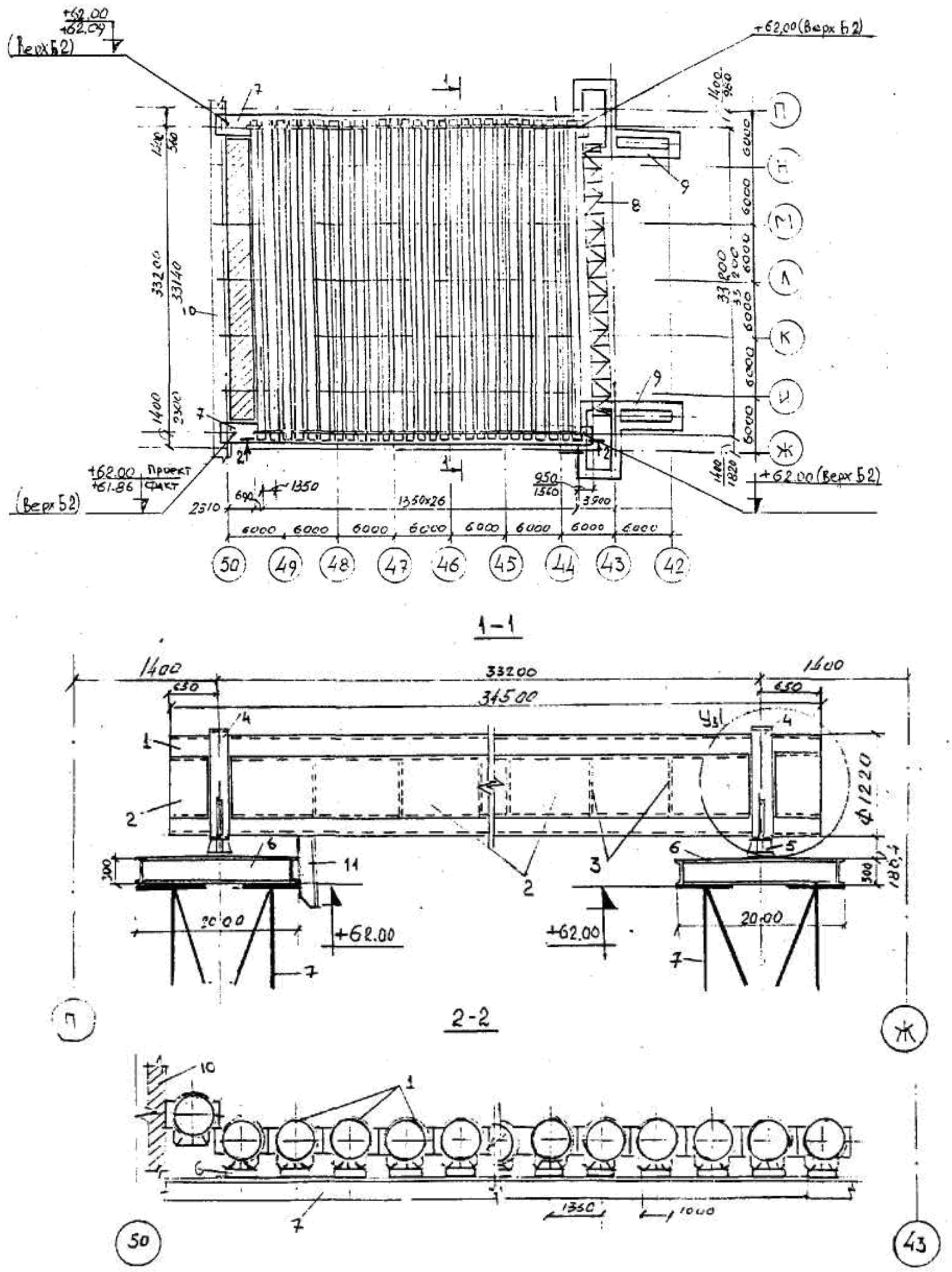


Figure A3.6-12 – Pipe rolling over the Central Hall

1 – rolling pipe ∅1220x15,2 mm; 2 – bent channel 800x190x3; 3 -rigidity rib;

4 - support ring from pipe ∅1200x15,2 mm with prolonging insert;

5 - supporting element; 6 – distribution platform; 7 - beam Б2;
8-beam Б5; 9 – ventilation shaft; 10 – wall along axis 50; 11-support

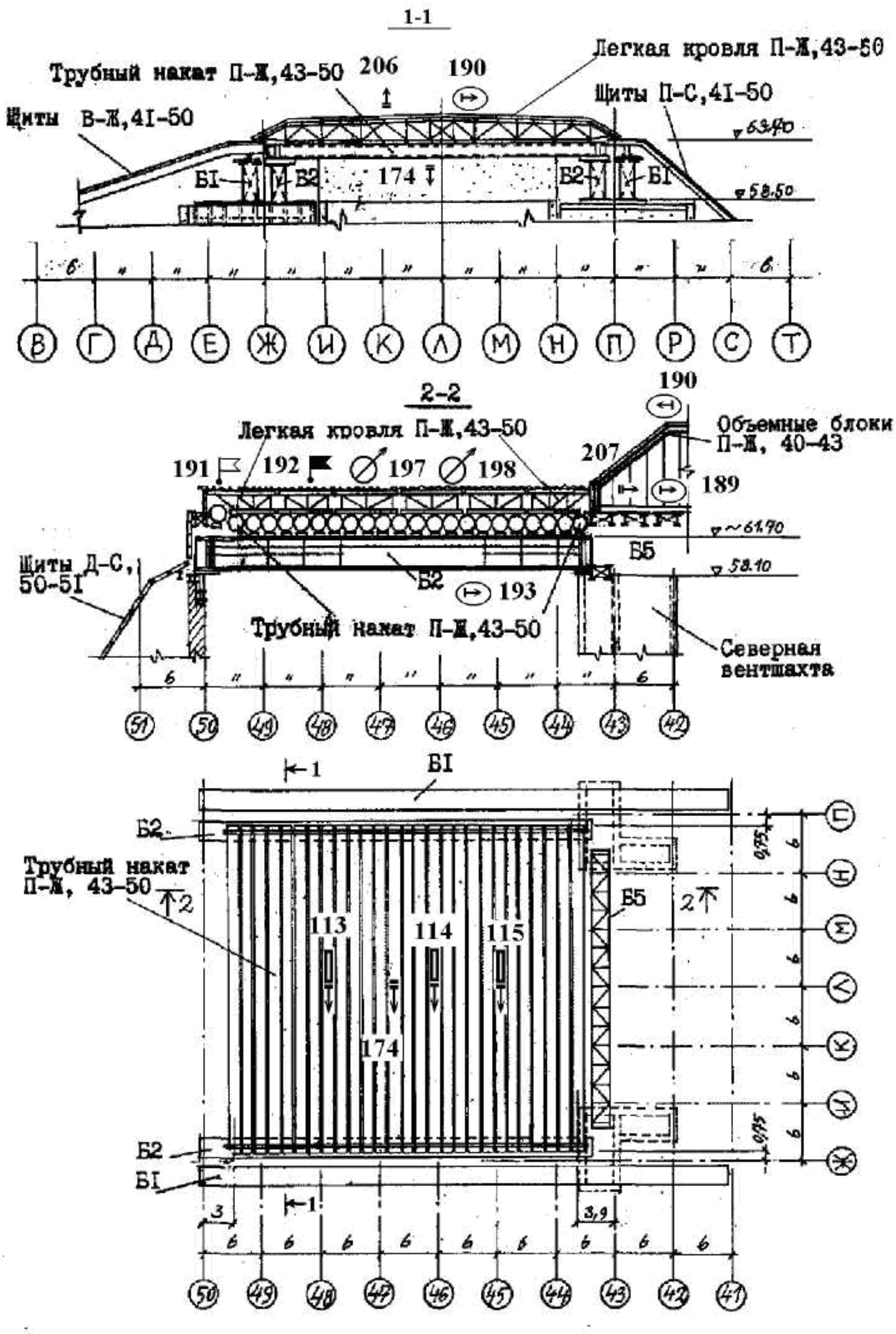
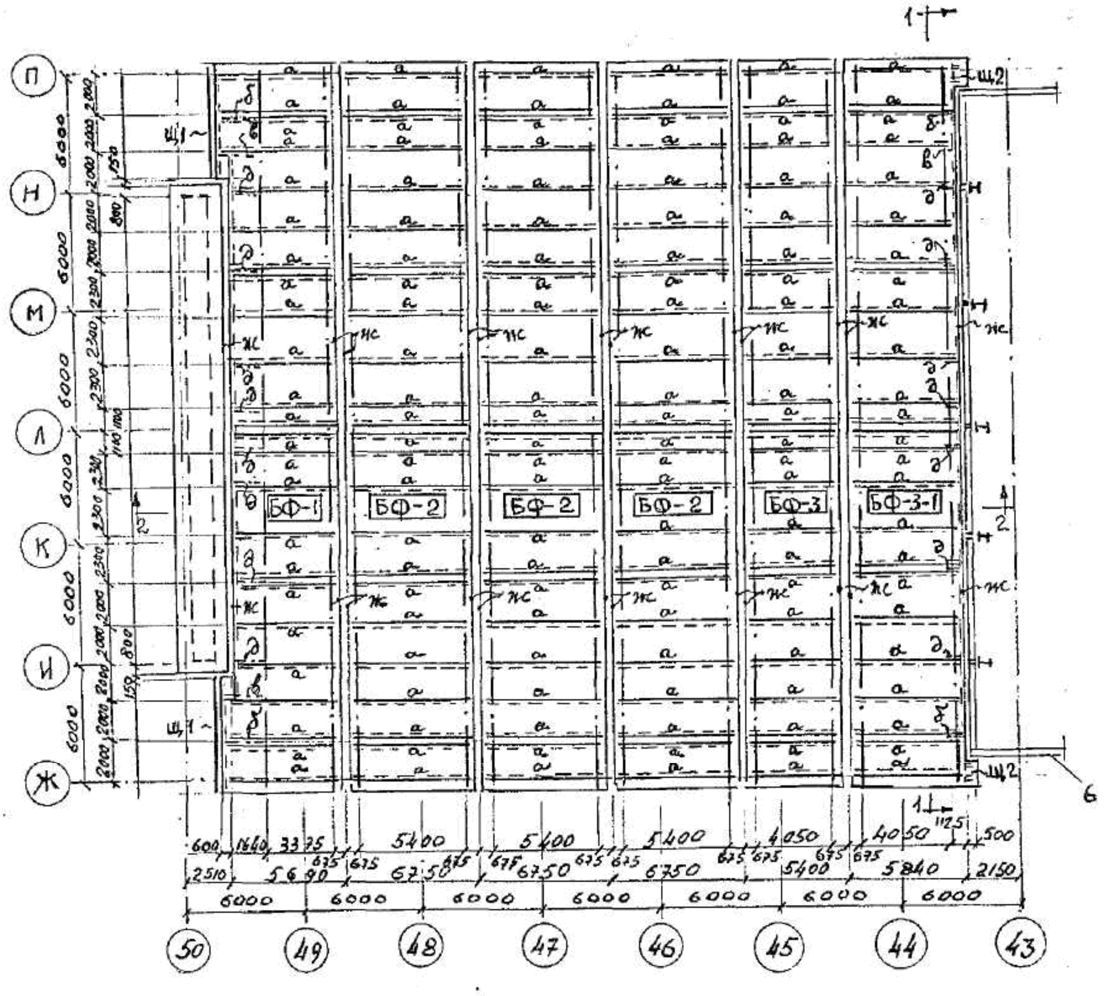


Figure A3.6-13 – Metal structures of pipe rolling and light roof



ВЕДОМОСТЬ ЭЛЕМЕНТОВ						
МАРКА	НАИМЕН ЭЛ-ТА	СЕЧЕНИЕ		РАСЧЕТН ОПОРН. УСИЛИЯ		
		ЭСКИЗ	СОСТАВ	M ТМ	N ТС	R ТС
БФ-1	БЛОК-ФЕРМЫ	СМ.	РИСУНКИ			
БФ-2						
БФ-3						
БФ-3-1						
а	ПРОГОНЫ	[	[18			3,5
б	ПОДКОСЫ	СМ. СХЕМУ	╥90×7		±4,0	
в		СМ. СХЕМУ	╥90×7		±4,0	
д		СМ. СХЕМУ	╥90×7		±4,0	
е	ОПОРНЫЕ БАЛКИ	[]	2[18			
Ж	ОГРАЖД. ЭЛ-Т	[	[18			
ВС-1	ВЕРТИК. СВЯЗИ	СМ.	РИСУНКИ		15.0	
ВС-2					15,0	
ВС-3					15,0	
ВС-4					15.0	
ВС-5					15.0	
С8	ГОРИЗ. СВЯЗИ	L	L90×7		±15,0	
П	ОПОРНЫЕ ПЛАСТИНЫ	—	—10×400			

Figure A3.6-14 – Layout scheme of roofing blocks and longitudinal girders along the upper belt of the frame

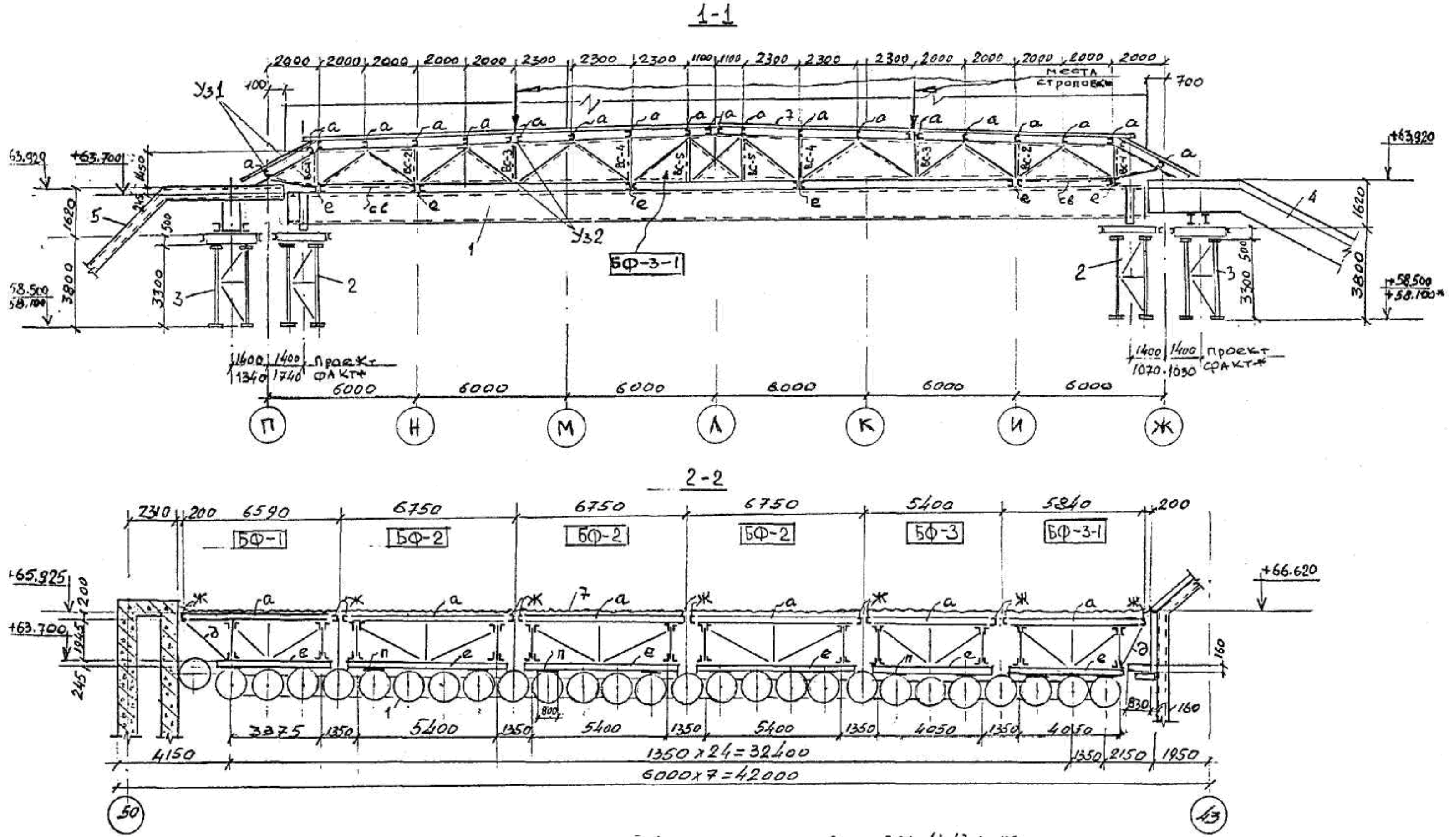


Figure A3.6-15 – Roofing covering blocks (lightweight roofing) over the Central Hall in Rows П-Ж, axes 43-50 (cuttings)

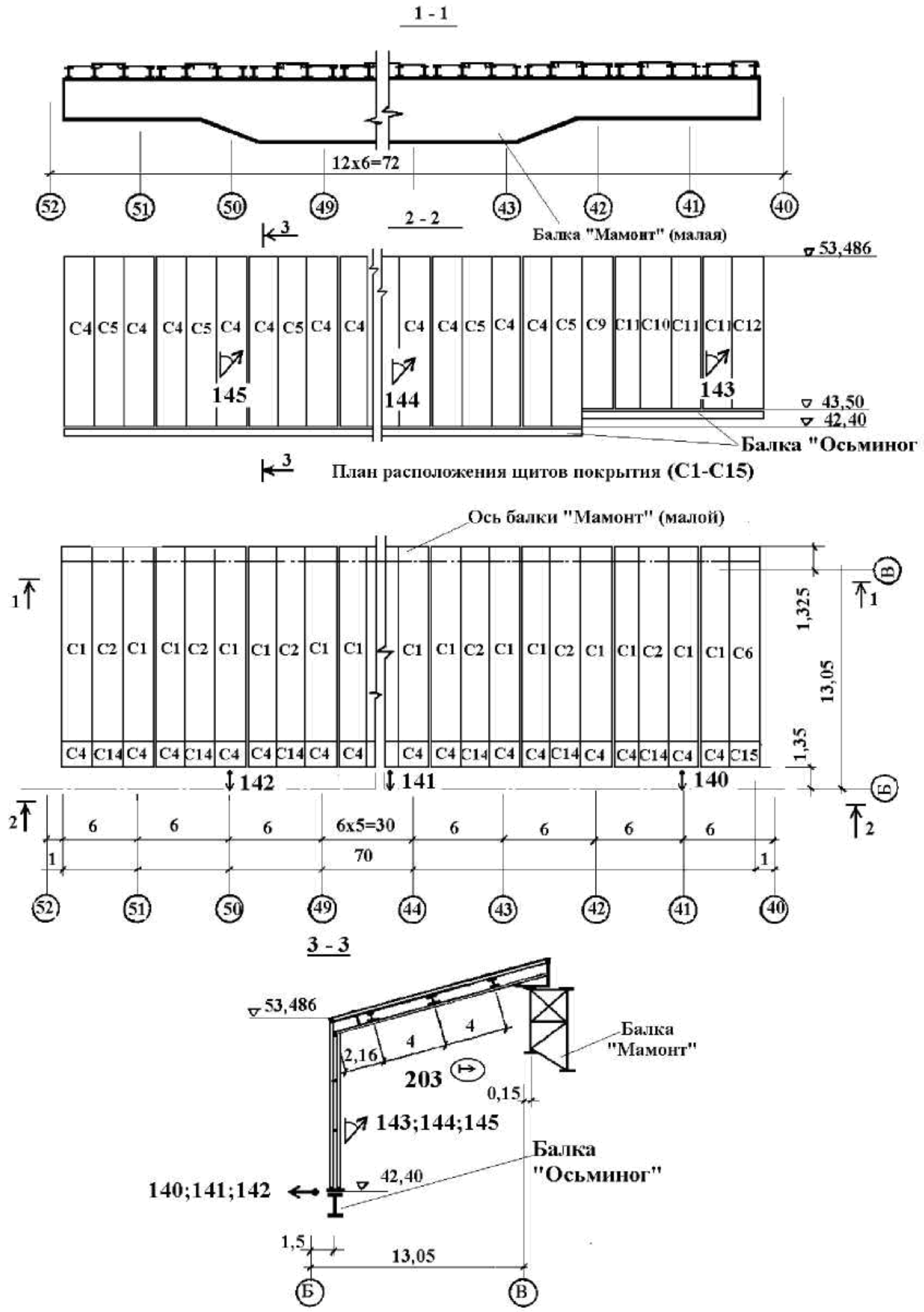


Figure A3.6-16 – Southern «hockey-sticks» of the covering in Rows Б-В and axes 40-52

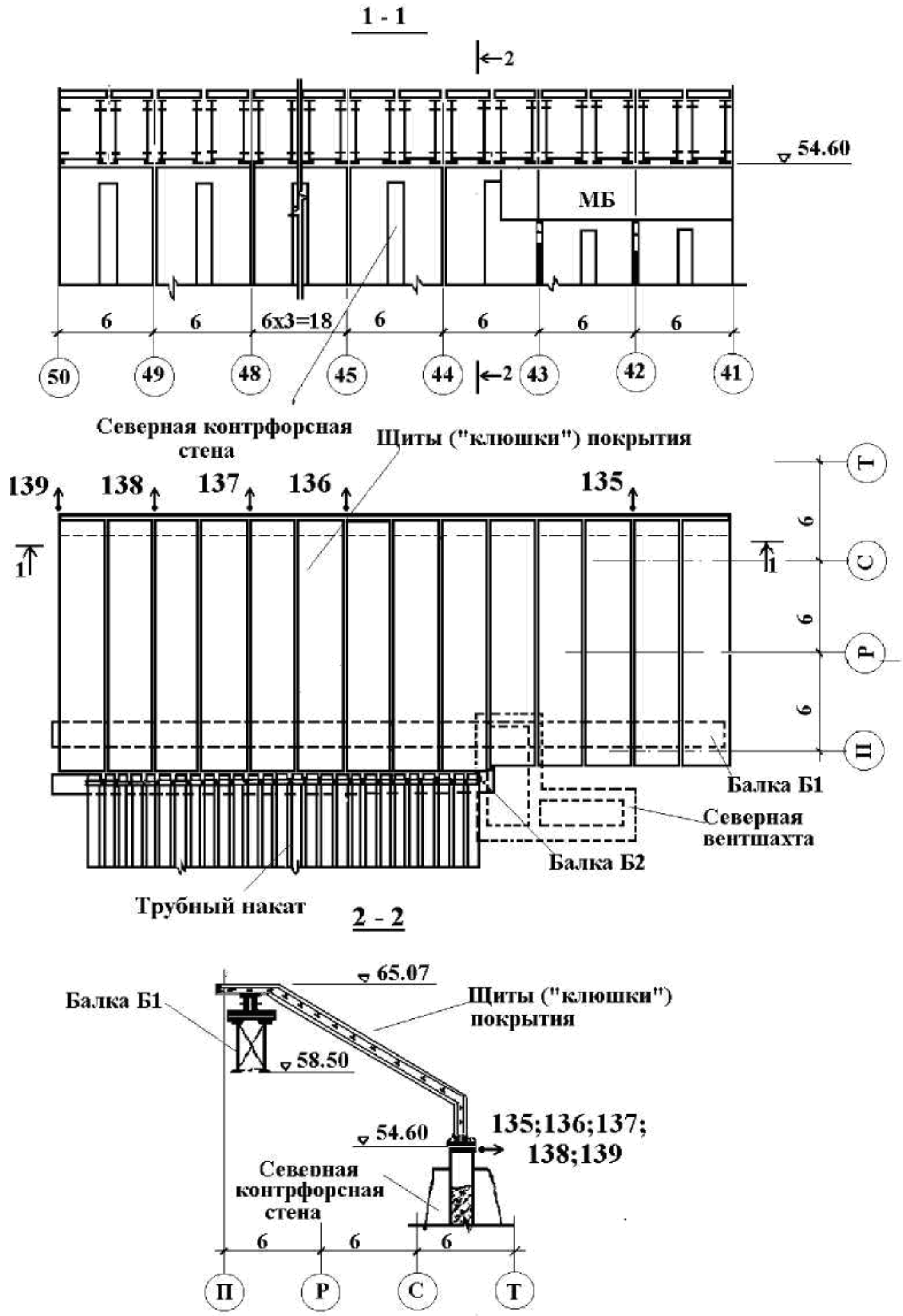


Figure A3.6-17 – Northern «hockey-sticks» of the covering in Rows П/Т and axes 41/50 (cutting 2-2)

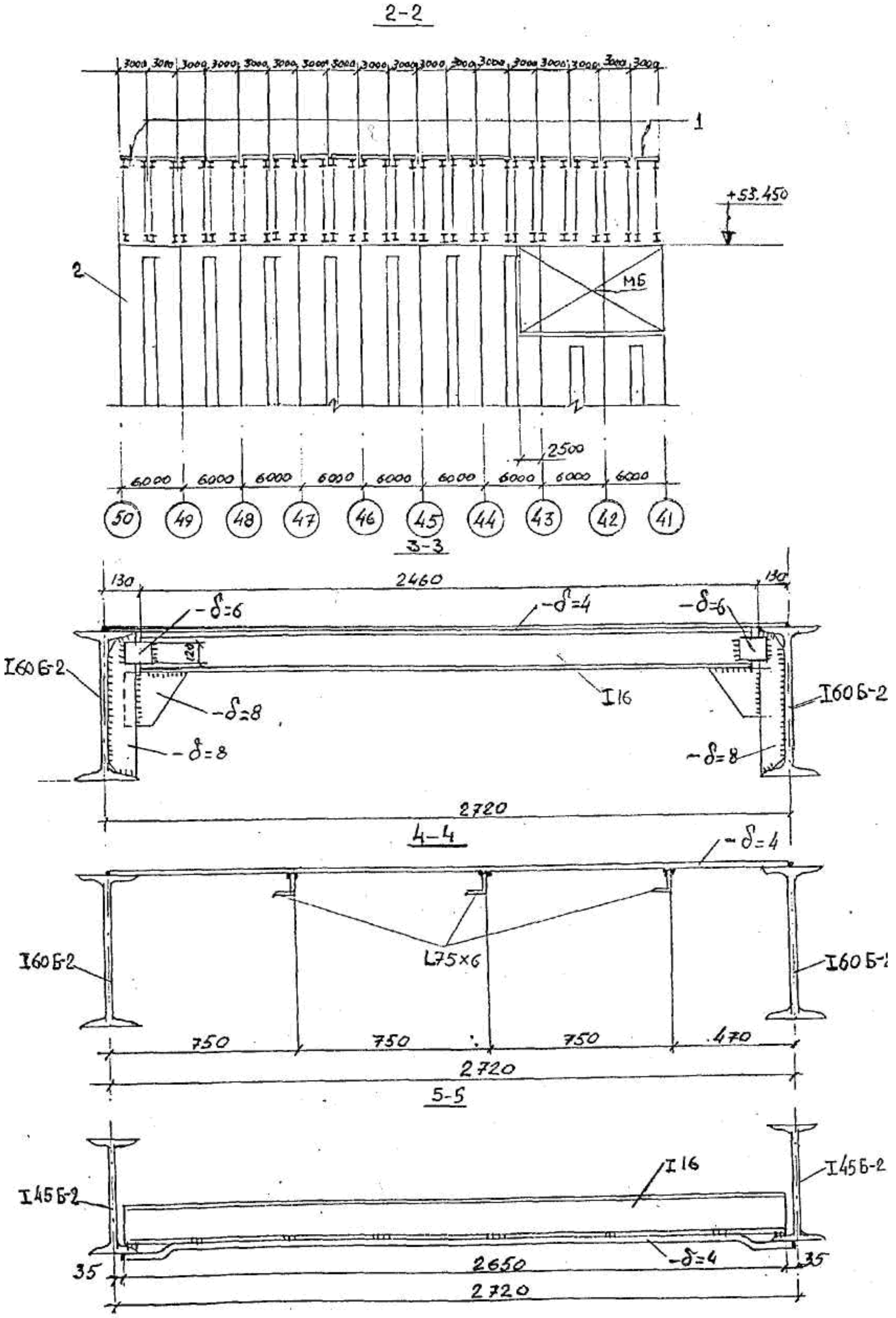


Figure A3.6-18 – Northern «hockey-sticks» of the covering in axes 41-50 between Rows П-С

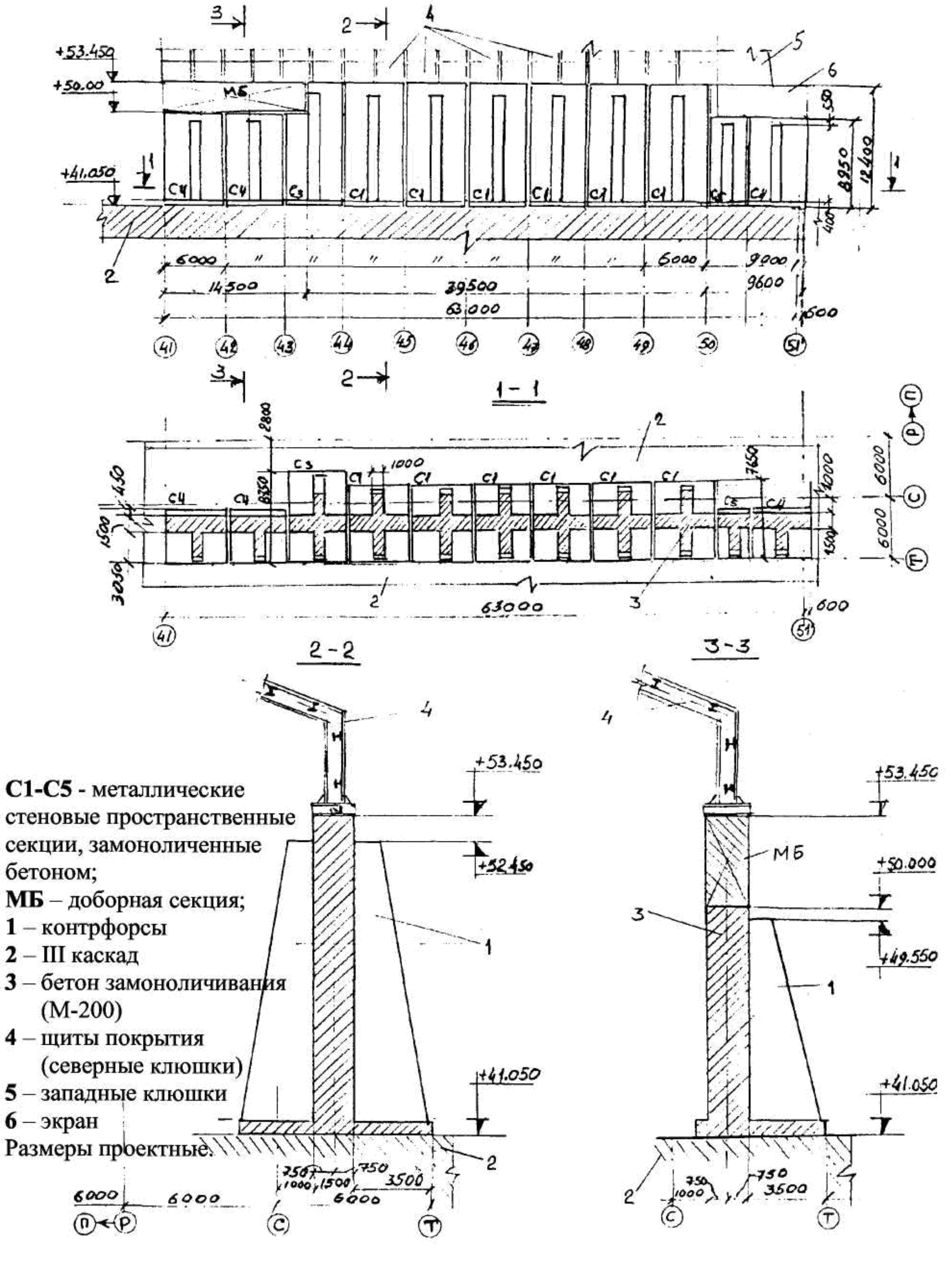


Figure A3.6-19 – Northern buttress wall

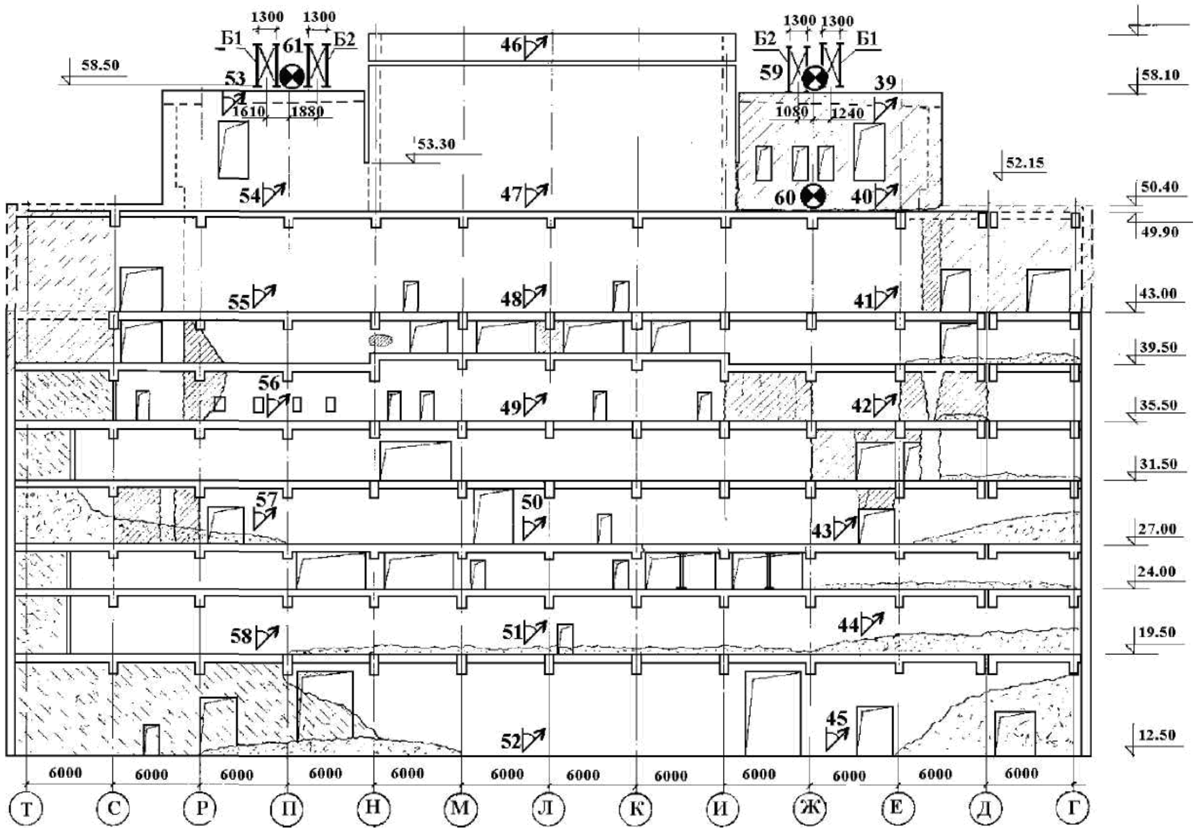
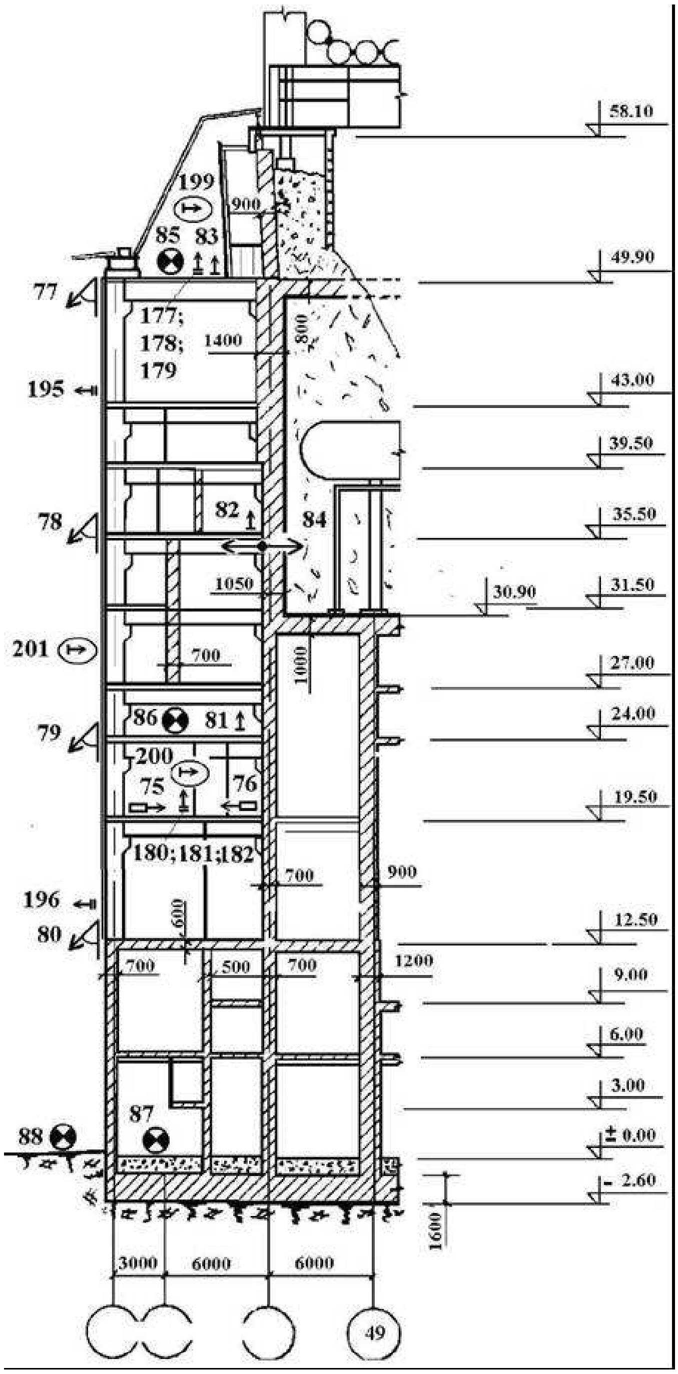


Figure A3.6-20 – Wall along axis 50



51' 51 t 50

Figure A3.6-21 – Framework in axes 49-51' and Rows И-Л-Т

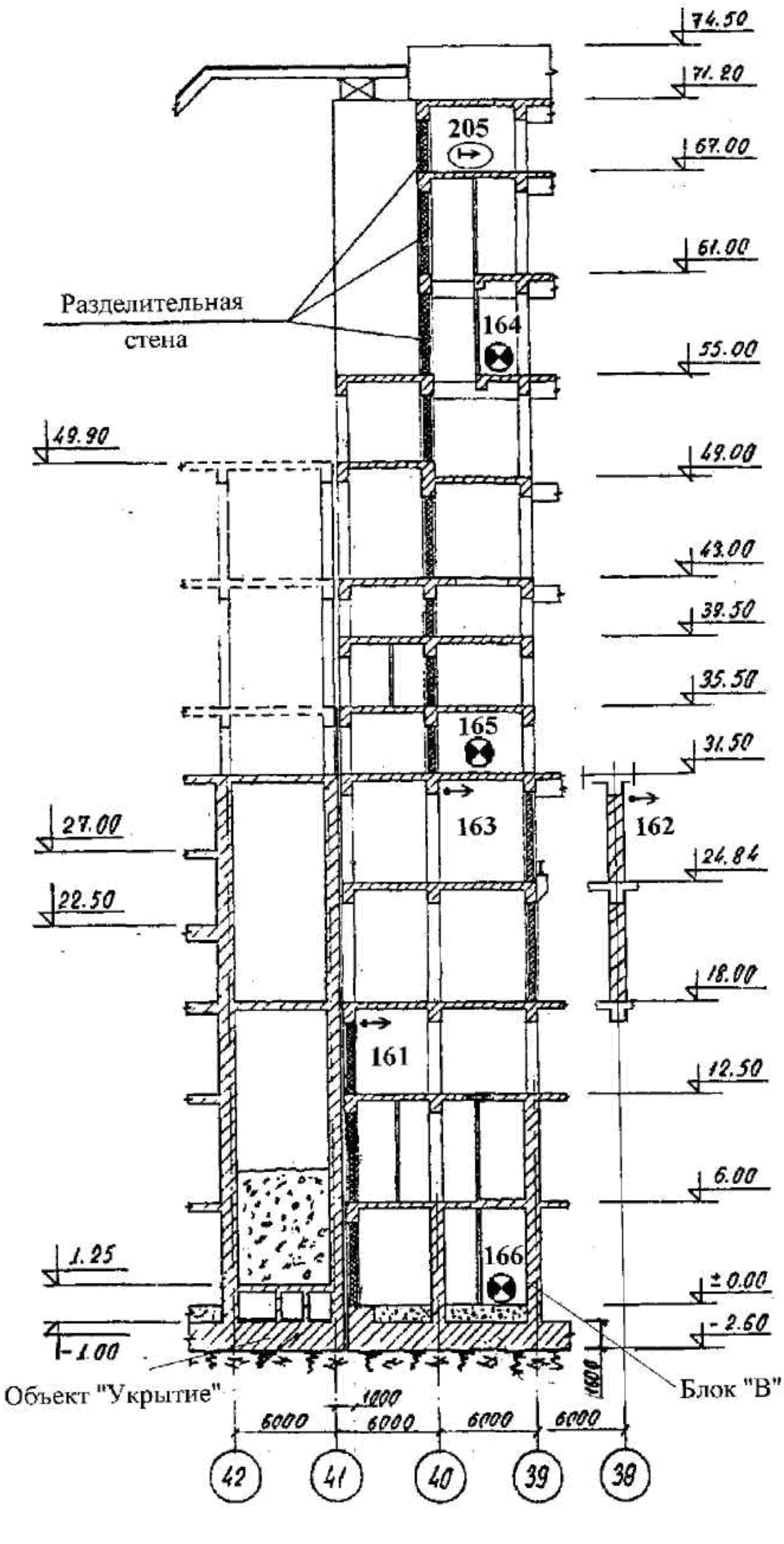


Figure A3.6-22 – **Separating wall OS and block B**

A3.7 – LIST OF USED LITERATURE

1. Conceptual and programme documents

№ п/п	Название документа (рус/укр)	Title of Document (in English)
1.1	Ссылка не используется	Reference is not used
1.2	Ссылка не используется	Reference is not used
1.3	Ссылка не используется	Reference is not used
1.4	Ссылка не используется	Reference is not used
1.5	Ссылка не используется	Reference is not used

2. Regulatory and branch documents

№ п/п	Название документа (рус/укр)	Title of Document (in English)
2.1	Норми радіаційної безпеки України. Державні гігієнічні нормативи. (НРБУ-97). ДГН.6.6.1-6.2.001-98	Radiation Safety Norms of Ukraine. State Hygienic Regulations. (НРБУ-97). ДГН. 6.6.1-6.2.001-98
2.2	Ссылка не используется	Reference is not used
2.3	Основні санітарні правила забезпечення радіаційної безпеки України (ОСПУ-2005). ДСП 6.177-2005-09-02	Basic Sanitary Rules for Radiation Protection of Ukraine (ОСПУ-2005). ДСП 6.177-2005-09-02
2.4	Ссылка не используется	Reference is not used
2.5	Ссылка не используется	Reference is not used
2.6	ДБН В.1.2-2:2006. Система обеспечения надежности и безопасности строительных объектов. Нагрузки и	ДБН В.1.2-2:2006. System for reliability and safety of construction objects. Loads and impacts. Design regulation. Ministry of

№ п/п	Название документа (рус/укр)	Title of Document (in English)
	воздействия. Нормы проектирования. Министерство регионального развития и строительства Украины, 2006	Regional Development and Construction of Ukraine, 2006
2.7	ДБН В.1.1-12:2006. Защита от опасных геологических процессов. Строительство в сейсмических районах Украины. Міністерство регіонального розвитку та будівництва України, 2006	ДБН В.1.1-12:2006. Protection from hazardous geological processes. Construction in seismic regions of Ukraine. Minisrtry of Regional Development and Construction of Ukraine, 2006
2.8	СНиП II-23-81*. Нормы проектирования. Стальные конструкции. Госстрой СССР. 1990	СНиП II-23-81*. Norms of design. Steel structures. Gosstroy of USSR. 1990
2.9	СНиП 2.03.01-84*. Бетонные и железобетонные конструкции. М.:ЦИТП Госстроя СССР, 1989	СНиП 2.03.01-84*. Concrete and Reinforced Concrete Structures. M., CITR. Gosstroy of USSR, 1989
2.10	ПиН АЭ-5.6. Нормы строительного проектирования АЭС с реакторами различного типа. Правила и нормы в атомной энергетике. МАЭ СССР. 1986	ПиН АЭ-5.6. Norms for Construction Design of Nuclear Plants with Reactors of Different Types. Regulations and Norms in Atomic engineering» MAE USSR, 1986
2.11	Ссылка не используется	Reference is not used
2.12	Ссылка не используется	Reference is not used
2.13	Классификация грунтов и других материалов, образующихся при выполнении земляных работ при реализации ПОМ ОУ, согласованная Минэкологии, МОЗ и Госатомрегулирования Украины, 2004	Classification of Soils and Other Materials Originated from Earth Works under OS SIP Realization. Approved by Ministry of Ecology, Ministry of Health and SNRC of Ukraine. 2004
2.14	Ссылка не используется	Reference is not used
2.15	СНиП 2.03.11-85. Захист будівельних конструкцій від корозії. Госстрой СССР, 1985	СНиП 2.03.11-85. Protection of Building Structures against Corrosion. Gosstroy of USSR, 1985
2.16	Обеспечение безопасности. Санитарные правила радиационной безопасности при выполнении и проектировании работ на ОУ (СПРБ-ОУ). СТП 3.014-2004.	Safety assurance. Sanitary Rules on Radiation Safety during execution and engineering of woks at object Shelter (СПРБ-ОУ). СТП 3.014-2004. Ministry of Health of Ukraine, 2004

№ п/п	Название документа (рус/укр)	Title of Document (in English)
	МОЗ України , 2004 г.	
	НАПБ 03.005-2002 (ВБН В.1.1-034-03.307-2003). Защита от пожара. Противопожарные нормы проектирования атомных электростанций с водо-водяными энергетическими реакторами. Минтопэнерго Украины, 2003	**НАПБ 03.005-2002 (ВБН В.1.1-034-03.307-2003).** Protection from fire. Fire- prevention design norms of nuclear power plants operating with water-moderated water-cooled reactors. Ministry of Fuel and Energy of Ukraine, 2003
	ДБН А.3.1-5-96. Управління, організація і технологія. Організація будівельного виробництва. Держбуд України, 1996	ДБН А.3.1-5-96. Management, organisation and technology. Construction industry organisation. Gosstroy of Ukraine, 1996
	НПАОП 45.2-7.02-80 (СНиП III-4-80*). Техника безопасности в строительстве. 1989	НПАОП 45.2-7.02-80 (СНиП III-4-80*). Safety measures for construction. 1989

3. COST, DSTU

№ п/п	Название документа (рус/укр)	Title of Document (in English)
3.1	Ссылка не используется	Reference is not used
3.2	Ссылка не используется	Reference is not used
3.3	Ссылка не используется	Reference is not used
3.4	Ссылка не используется	Reference is not used
3.5	Ссылка не используется	Reference is not used
3.6	Ссылка не используется	Reference is not used

4. Operation and technical documents of ChNPP

4.1 Provisions

№ п/п	Название документа (рус/укр)	Title of Document (in English)
4.1.1	Ссылка не используется	Reference is not used
4.1.2	Положение по обращению с твердыми радиоактивными отходами на ЧАЭС. 29П-С. ЦПТРО, 2006	Regulation on SRAW management at ChNPP. 29P-S. SWPS, 2006
4.1.3	Контрольные уровни радиационной безопасности. 41П-С. ЦРБ, 2006	The Shelter Radiation Safety Reference Levels. 41P-S. RSD, 2006

4.2. Programs

№ п/п	Название документа (рус/укр)	Title of Document (in English)
4.2.1	Интегрированная программа обращения с РАО на этапе прекращения эксплуатации ЧАЭС и преобразования объекта «Укрытие» в экологическую безопасную зону. 2ПР-С. 2007	Integrated programme of RAW management at the ChNPP decommissioning stage and the Shelter conversion into an ecologically safe system. 2PR-S. 2007

4.3 Regulations and operations manuals

№ п/п	Название документа (рус/укр)	Title of Document (in English)
4.3.1	Технологический регламент объекта «Укрытие реактора блока №4 Чернобыльской АЭС». 1Р-ОУ. 2001	Technological regulations for Chernobyl NPP Unit 4 object Shelter. 1R-OS. 2001
4.3.2	Инструкция по эксплуатации системы сбора и удаления ЖРО объекта «Укрытие». 15Э-ЦЭОУ (НБК)	Instruction for operation of system for collection and removal of liquid radiation wastes of Object Shelter. 15E-OSOS (NSC)
4.3.3	Типовая программа проведения работ по перемещению твердых ВАО объекта «Укрытие» к месту временного хранения. 36ПР-ЦПТРО. 2005	Model Program of the Shelter Solid HLW Displacement to the Place of Temporary Storage. 36PR- SWPS. 2005
4.3.4	План ГСП ЧАЭС реагирования на аварии и чрезвычайные ситуации. 32П-С. 2007	Plan of SSE ChNPP response to accidents and emergency situations. 32P-S, 2007

№ п/п	Название документа (рус/укр)	Title of Document (in English)
4.3.5	Регламент работы площадки временного складирования грунта, разрабатываемого при строительстве объектов ПОМ. 23Э-ЦПТРО. 2005	Regulations of the Site for temporary storage of grounds, excavating during SIP objects construction. 23E- SWPS, 2005
4.3.6	Схема расположения мест для сбора ТРО на промплощадке ГСП ЧАЭС. 1С-ЦПТРО, 2005 г.	Layout of SRAW collection sites at SSE ChNPP industrial site. 1S- SWPS, 2005
4.3.7	Инструкция по учету активности ТРО, вывозимых на захоронение из объекта «Укрытие». 21Э-ЦРБ ОУ, 2003 г.	Instruction on Activity Keeping Records of SRAW Transporting from the Shelter for Disposal. 21E- RSD OS, 2003
4.3.8	Ссылка не используется	Reference is not used
4.3.9	Регламент радиационного контроля ГСП ЧАЭС на этапе прекращения эксплуатации энергоблоков и поддержания в безопасном состоянии объекта «Укрытие». 45Э-РБ. 2005 г.	Regulations on SSE ChNPP Radiation Monitoring at the Stage of Power Units Operation Termination and Support of the Shelter Safe Status. 45E-RS. 2005
4.3.10	Инструкция по эксплуатации аппаратуры измерения расхода воздуха через байпасную линию вытяжной вентиляции. 30Э-ЦЭОУ(НБК). 2007 г.	Instruction on operation of air consumption measuring equipment through bypass line of exhaust ventilation. 30E-OSOS (NSC). 2007
	Технологические радиационные критерии. 39Э-ЦРБ. 2006 г.	Process radiation criteria. 39E-RSD.2006

4.4 Methodology

№ п/п	Название документа (рус/укр)	Title of Document (in English)
4.4.1	Методика расчета доз внутреннего облучения персонала объекта Укрытие (по результатам оперативного контроля). Инв. ТО ОУ №667. 27.12.2000	Methodology of calculating the Shelter personnel internal exposure dose (based on on-line monitoring results). Inv. Shelter Technical Division’s Inventory No.667 of 27.12.2000
4.4.2	Ссылка не используется	Reference is not used

4.5 Reports

№ п/п	Название документа (рус/укр)	Title of Document (in English)
4.5.1	Отчет о состоянии безопасности объекта «Укрытие» за 1998	Shelter Safety Status Report for 1998 (annual)
4.5.2	Отчет о состоянии безопасности объекта «Укрытие» за 1999	Shelter Safety Status Report for 1999 (annual)

№ п/п	Название документа (рус/укр)	Title of Document (in English)
4.5.3	Отчет о состоянии безопасности объекта «Укрытие» за 2000	Shelter Safety Status Report for 2000 (annual)
4.5.4	Отчет о состоянии безопасности объекта «Укрытие» за 2001	Shelter Safety Status Report for 2001 (annual)
4.5.5	Отчет о состоянии безопасности объекта «Укрытие» за 2002	Shelter Safety Status Report for 2002 (annual)
4.5.6	Отчет о состоянии безопасности объекта «Укрытие» за 2003	Shelter Safety Status Report for 2003 (annual)
4.5.7	Звіт про стан безпеки об’єкта «Укриття» за 2004	Shelter Safety Status Report for 2004 (annual)
4.5.8	Звіт про стан безпеки об’єкта «Укриття» за 2005	Shelter Safety Status Report for 2005 (annual)
4.5.9	Удален	
4.5.9.a	Звіт про стан безпеки об’єкта «Укриття» за 2006	Shelter Safety Status Report for 2006(annual)
4.5.9.b	Звіт про стан безпеки об’єкта «Укриття» за 2007	Shelter Safety Status Report for 2007annual)
4.5.10	Отчет о состоянии радиационной безопасности в ГСП ЧАЭС за 2005 г.	SSE ChNPP Radiation Safety Status Report, 2005
4.5.11	Ссылка не используется	Reference is not used
4.5.12	Отчет о состоянии безопасности объекта «Укрытие». 2002 г. (Анализ достигнутого на 2001 г. уровня безопасности ОУ)	Shelter safety status report. 2002 (Analysis of OS Safety Status Obtained as of 2001)
4.5.13	Ссылка не используется	Reference is not used
4.5.14	Ссылка не используется	Reference is not used
4.5.15	Ссылка не используется	Reference is not used
4.5.1	Ссылка не используется	Reference is not used

№ п/п	Название документа (рус/укр)	Title of Document (in English)
6		
4.5.17	Ссылка не используется	Reference is not used
4.5.18	Ссылка не используется	Reference is not used
4.5.19	Ссылка не используется	Reference is not used
4.5.20	Ссылка не используется	Reference is not used
4.5.21	Ссылка не используется	Reference is not used
4.5.22	Ссылка не используется	Reference is not used
4.5.23	Ссылка не используется	Reference is not used
4.5.24	Концентрации и дисперсность радиоактивных аэрозолей на крыше объекта «Укрытие» и на прилегающей к нему территории в 2002 г. Огородников Б.И., Будыка А.К. и др. Проблемы Чернобыля вып.13, 2003	Concentrations and dispersity of radioactive aerosols on the Shelter roof and on its adjacent territory in 2002. B.I. Ogorodnikov, A.K. Budyk et al. Problems of Chornobyl, Issue 13. 2003
4.5.25	Ссылка не используется	Reference is not used
4.5.26	Ссылка не используется	Reference is not used
4.5.27	Ссылка не используется	Reference is not used
4.5.2	Ссылка не используется	Reference is not used

№ п/п	Название документа (рус/укр)	Title of Document (in English)
8		
4.5.29	Ссылка не используется	Reference is not used
4.5.30	Ссылка не используется	Reference is not used
4.5.31	Ссылка не используется	Reference is not used
4.5.32	Ссылка не используется	Reference is not used
4.5.33	Отчет о НИР «Выполнение работ по анализу неорганизованных выбросов из объекта «Укрытие» (договор №103/98У), МНТЦ «Укрытие», 1998	Report on NIR “Performance of works on analysis of non-organized releases from the Shelter (contract No103/98У), ISTC the Shelter, 1998
4.5.34	Отчет о НИР «Контроль неорганизованных выбросов из объекта «Укрытие» (договор №132/2000), МНТЦ «Укрытие», 2001	Report on NIR “Monitoring of non-organized releases from the Shelter (contract No132/2000), ISTC the Shelter, 2001
4.5.35	Ссылка не используется	Reference is not used
4.5.36	Ссылка не используется	Reference is not used
4.5.37	SIP-P-PM-22-460-SAR-124-04. Отчет о состоянии безопасности объекта «Укрытие». Ред. 4, 28.02.2008	SIP-P-PM-22-460-SAR-124-04. “Shelter” Object Safety Analysis Report. Rev. 4, 28.02.2008
4.5.38	Отчет о НИР «Радиогидроэкологический мониторинг в районе объекта «Укрытие»(договор 07/2005), НИЦ РПИ,2006	Report of NIR “Radiohydromonitoring of environment in the region of OS”,(Contract 07/2005), SRC RSR, 2006
4.5.39	Ссылка не используется	Reference is not used
4.5.40	Отчет о НИР «Исследование скорости коррозии металла строительных конструкций «Объекта «Укрытие» (договор №700), 2000 г.	Report on NIR “Research of steel speed corrosion of object “Shelter” constructures (contract No700), 2000
4.5.41	Заключительный отчет в соответствии с результатами комплексных инженерно-радиологических исследований блоков № 2, 3 ЧАЭС, 14.50.420.300-01.53	Summary final report in accordance with findings of complex ngineering and radiation survey of power units № 2, 3 ”Chernobyl NPP” , 14.50.420.300-01.53

4.6 Passports

№ п/п	Название документа (рус/укр)	Название документа (англ)
4.6.1	Ссылка не используется	Reference is not used
4.6.2	Ссылка не используется	Reference is not used
4.6.3	Ссылка не используется	Reference is not used
4.6.4	Ссылка не используется	Reference is not used

4.7 Acts (Reports)

№ п/п	Название документа (рус/укр)	Title of Document (English)
4.7.1	Ссылка не используется	Reference is not used
4.7.2	Ссылка не используется	Reference is not used
4.7.3	Ссылка не используется	Reference is not used
4.7.4	Ссылка не используется	Reference is not used
4.7.5	Ссылка не используется	Reference is not used
4.7.6	Ссылка не используется	Reference is not used
4.7.7	Ссылка не используется	Reference is not used
4.7.8	Ссылка не используется	Reference is not used
4.7.9	Ссылка не используется	Reference is not used
4.7.10	Ссылка не используется	Reference is not used
4.7.11	Ссылка не используется	Reference is not used
4.7.12	Ссылка не используется	Reference is not used

№ п/п	Название документа (рус/укр)	Title of Document (English)
4.7.13	Ссылка не используется	Reference is not used

5. Documents of OS SIP

5.1 NSC

№ п/п	Название документа (рус/укр)	Title of Document (English)
5.1.1	Концептуальный проект (ТЭО) безопасного конфайнмента. Пояснительная записка. SIP K 00 21 000 EXN 001 01	Conceptual design (CD) of safe confinement. Explanatory note. SIP K 00 21 000 EXN 001 01
5.1.2	Ссылка не используется	Reference is not used
5.1.3	Стратегия дальнейшей реализации проекта НБК. SIP-P-PM-21-330-EXN-004-01. ред. 2 от 23.04.04. Дополнение к Пояснительной записке SIP K 0021 000 EXN 001 01. 2004	Strategy of further NSC design implementation SIP-P-PM-21-330-EXN-004-01. Revision 2 of 23 April 2004. Appendix to Explanatory note SIP K 0021 000 EXN 001 01.2004
5.1.4	КП НБК. Отчет по анализу грунтов. FD-303. 09.05.2003	CD NSC. Report of grounds analysis. FD-303. 09.05.2003
5.1.5	КП НБК. Оценка воздействия на окружающую среду. SIP-P-TM-21-330-EIA-101-01, 2003	CD NSC. Evaluation of Impact onto Environment. SIP-P-TM-21-330-EIA-101-01, 2003
5.1.6	КП НБК. Анализ ALARA доз, полученных во время строительства. Док. SA-305, ред. А от 30.05.2003	CD NSC. ALARA dose analysis taken in the course of construction. Doc.SA-305, Rev.A dated 30.05.2003
5.1.7	Данные дозиметрических обследований монтажной зоны НБК	Data on dose survey of NSC Installation Area
5.1.8	КП НБК (ЧАЭС + Блок 4) АБ- характеристики площадки НБК и сбор других данных. Док. SA-301 ред. А от 24.10.02	CD NSC (ChNPP +Unit4) AB- Characteristics of NSC site and acquisition of another data. Doc.SA-301. Rev.A dated by 24.10.02
5.1.9	Проект демонтажа	Deconstruction Design
5.1.9a	Демонтаж основных балок, ред. B, DD-303	Deconstruction of Main Beams, rev. B, DD-303

№ п/п	Название документа (рус/укр)	Title of Document (English)
5.1.9b	Исследование транспортной системы демонтажа, ред. В, DD-304	Deconstruction Indoor Transportation System, rev.B, DD-304
5.1.9c	Демонтаж внутренних конструкций, ред. В, DD-305	Deconstruction of Internal Structures, rev. B, DD-305
5.1.9d	Технологическое оборудование обращения с демонтируемыми элементами и сопутствующими РАО, ред. В, DD-306	Dismantled Element Process Equipment and Related Radioactive Waste (RAW) Management, rev. B, DD-306
5.1.10	План характеризации воды, аналитическая программа, процедуры, перечень материалов (ПОМ Задание 13). D 3.1. NUTECO-02-13-001, 2002	Characterisation Plan, Analytical Programme, Procedures, List of Materials and Equipment (SIP Task 13). D 3.1. NUTECO-02-13-001, 2002
5.1.11	Ссылка не используется	Reference is not used
5.1.12	Ссылка не используется	Reference is not used
5.1.13	Ссылка не используется	Reference is not used
5.1.14	Ссылка не используется	Reference is not used
5.1.15	КП НБК. SA-304 ред.А. 30.12.2002 Анализ Безопасности – Анализ АЛАРА Демонтажных Работ.	Safety Analysis – ALARA Analysis of Dismantle Works. CD NSC. SA-304 Revision 12.30.2002
5.1.16	SIP-P-TM-21-330-DC-101-01. Проектные критерии и требования к НБК. 31.10.03	SIP-P-TM-21-330-DC-101-01. NSC Design Criteria and Requirements. 31.10.03
5.1.17	SIP-P-PM-21-330-EXN-005-01.ТЭО. Концептуальный проект НБК. Перечень дополнительных требований по результатам комплексной государственной экспертизы ТЭО (КП) НБК для учета на последующих стадиях проектирования. 2004	SIP-P-PM-21-330-EXN-005-01.FS. NSC Conceptual Design. List of the Addition Requirements Based on the Results of State Comprehensive Examination of NSC FS (CD) for Utilization in the Subsequent Design Stages. 2004
5.1.21	Разъяснение технических требований относительно вспомогательных систем и объектов НБК (ред.3), SIP-P- PM-22- 460-TSN- 102-03, 05.07.2006	Technical requirements clarification for NSC auxiliary systems and facilities (rev. 3), SIP-P- PM-22- 460-TSN- 102-03, 05.07.2006
5.1.22	КП НБК. Описание проекта, расчеты и чертежи интегрированной системы управления НБК, CD-301/SD-302	CD NSC. Description of Facility, Calculations and Drawings of NSC Integrated Management System, CD-301/SD-302

№ п/п	Название документа (рус/укр)	Title of Document (English)
5.1.23	Ссылка не используется	Reference is not used
5.1.24	Ссылка не используется	Reference is not used
5.1.25	Ссылка не используется	Reference is not used
5.1.26	КП НБК. FD-305. Проект фундамента – Стратегия обращения с радиоактивными отходами при проведении земляных работ. 2003	CD NSC. FD-305. The project of the Foundation Design - Strategy of the management with radioactive waste at carrying out of excavations. 2003
	SIP-P-22-046-SOW-052-010. Проектирование, строительство, ввод в эксплуатацию НБК. Объемы работ. (ред. 10)	SIP-P-22-046-SOW-052-010 rev. 10. Designing, Construction, Commissioning of the New Safe Confinement. Scope of work
1.10.41	SIP-P-PM-22- 460-TSN-102-03. Разъяснение технических требований относительно вспомогательных систем и объектов НБК (ред.3). ГУП ПОМ. 05.07.2006	SIP-P-PM-22- 460-TSN-102-03. Technical requirements clarification for NSC auxiliary systems and facilities (rev. 3). SIP PMU. 05.07.2006
	W03-CDSD-SCh-RUS-CFM. Проект ДБКП. Ред. 3, 05.04.2007	W03-CDSD-SCh3-ENG-CFM. Draft of CDSD. Rev. 3, 05.04.2007

5.2. Program and technical decisions, concepts and strategies

№ п/п	Название документа (рус/укр)	Title of Document (English)
5.2.1	Ссылка не используется	Reference is not used
5.2.2	Ссылка не используется	Reference is not used
5.2.3	Ссылка не используется	Reference is not used
5.2.4	Ссылка не используется	Reference is not used
5.2.5	Ссылка не используется	Reference is not used
5.2.6	Ссылка не используется	Reference is not used
5.2.7	Ссылка не используется	Reference is not used
5.2.8	Ссылка не используется	Reference is not used

№ п/п	Название документа (рус/укр)	Title of Document (English)
5.2.9	Ссылка не используется	Reference is not used
5.2.10	Концептуальное техническое решение по обращению с жидкими радиоактивными отходами в процессе преобразования объекта «Укрытие» в экологически безопасную систему. ГСП ЧАЭС, 2006	Conceptual Technical Decision On liquid RAW management during Shelter Object transformation into an ecologically safe system. ChNPP, 2006
5.2.11	Ссылка не используется	Reference is not used
5.2.12	SIP-P-DI-19-120-STG-083-02. Стратегия обращения с ТСМ и радиоактивными отходами объекта «Укрытия». План дальнейших действий. ГУП ПОМ, 2005	SIP-P-DI-19-120-STG-083-02. Strategy of OS FCM and RAW management. Further action plan. SIP PMU, 2005
5.2.13	Стратегия извлечения ТСМ и обращения с РАО. П7. НАЭК «Энергоатом» 20.12.2000, SIP-PMU P7.	EnergoAtom P7 decision paper. “FCM removal and Waste Management Strategy”, 20.12.2000, SIP-PMU P7
5.2.14	Ссылка не используется	Reference is not used
	«Технічне рішення по організації транспортування обмивочних вод с СП-1430 в спецканалізацію ДСП ЧАЕС спецавтотранспортом»	Technical decision on arranging removal of ChF-1430 drains to SSE ChNPP special sewage by special trucks

5.3. Other SIP projects

№ п/п	Название документа (рус/укр)	Title of document (in English)
5.3.1	Рабочий проект для санпропускника на 1430 мест для объекта «Укрытие». Пояснительная записка. SIP03-2-006-117-100-П301. 2003 г.	Detail design for object Shelter 1430 places changing facility. Explanatory note. 51PO3-2-006-117-100-П301. 2003
5.3.2	Проектирование и строительство санпропускника на 1430 мест. Оценка воздействия на окружающую среду. SIP UKH 00 01 EAR 02 000. 2003 г.	Design development and construction of Changing Facility for 1430 places. Environment Impact assessment. SIP UKH 0001 EAR 02 000. 2003
5.3.3	Ссылка не используется	Reference is not used
5.3.4	Проектирование и строительство внешних инженерных коммуникаций и вспомогательных сооружений. Том 3. Отчёт	Design development and construction of external engineering networks and auxiliary facilities. Volume 3. Safety evaluation report

№ п/п	Название документа (рус/укр)	Title of document (in English)
	по оценке безопасности. 2004 г.	
5.3.5	Ссылка не используется	Reference is not used
5.3.6	Ссылка не используется	Reference is not used
5.3.7	Интегрированная автоматизированная система контроля. Проектные основы. D1. NUTECO-03-DBP-001, 2002 г.	Design bases. Integrated Automated Monitoring System. D1. NUTECO. NUTECO-03-DBP-001, 2002
5.3.8	Ссылка не используется	Reference is not used
5.3.9	Ссылка не используется	Reference is not used
5.3.10	Ссылка не используется	Reference is not used
5.3.11	Ссылка не используется	Reference is not used
5.3.12	Ссылка не используется	Reference is not used
5.3.13	Измерения наземных полей гамма-излучения. Фаза 2. Отчет по измерениям. Задача №1. SIP K 01 21 310 MR 003 02. 2004 г.	Measurements of ground gamma-radiation fields. Phase 2. Report on measurements. Task No1. SIP K 01 21 310 MR 003 02. 2004
5.3.14 5.3.15	Задача №7. Геотехнические исследования. Отчет о геотехнических исследованиях. Док.7.3. 2000 г.	Task #7. Geotechnical investigations. Report on geotechnical investigations. Doc.7.3. 2000
5.3.16	Ссылка не используется	Reference is not used
5.3.17	Ссылка не используется	Reference is not used
5.3.18	Ссылка не используется	Reference is not used
5.3.19	Ссылка не используется	Reference is not used
5.3.20	Анализ конструкций и отчет об их состоянии WBS A06 40000 - Док. 6.3. Ред.3. 21.03.2000 (2 книги)	Analysis of Structures and Report on their State. WBS A06 40000 – Document 6.3, Revision 3, books 1 and 2. 21.03.2000
5.3.21	Структурный отчет (Отчет по результатам выполненных исследований) Док. 6.4, 2000г. (2 книги). 2000 г.	Structural Report (report by results of researches). (WBS A06 50000 - Document 6.4). Books 1 and 2. 2000
5.3.22	Ссылка не используется	Reference is not used

№ п/п	Название документа (рус/укр)	Title of document (in English)
5.3.23	Ссылка не используется	Reference is not used
5.3.24	Ссылка не используется	Reference is not used
5.3.25	Ссылка не используется	Reference is not used
5.3.26	Ссылка не используется	Reference is not used
5.3.27	Ссылка не используется	Reference is not used
5.3.28	Рабочий документ по стабилизационным мероприятиям. Итоговый отчет по радиационной безопасности. SIP-K-03-01-000-RSR-003-03, 2003 г.	Working document on the stabilization measures. Summary Report on radiation safety. SIP-K-03-01-000-RSR-003-03. 2003
5.3.29	Ссылка не используется	Reference is not used
5.3.30	Ссылка не используется	Reference is not used
5.3.31	Ссылка не используется	Reference is not used
5.3.32	Рабочий проект по стабилизационным мероприятиям. Моделирование и расчеты по Западной зоне. (СМ №5 и №11). SIP K 02 04 005 CLN 001 03. 2003 г.	Working design on stabilization measures. Modeling and calculations on western zone. (SM No 5 and No 11). SIP K 02 04 005 CLN 001 03. 2003
5.3.33	Ссылка не используется	Reference is not used
5.3.34	Ссылка не используется	Reference is not used
5.3.35	Ссылка не используется	Reference is not used
5.3.36	Ссылка не используется	Reference is not used
5.3.37	Ссылка не используется	Reference is not used
5.3.38	Ссылка не используется	Reference is not used
5.3.39	Ссылка не используется	Reference is not used
5.3.40	Ссылка не используется	Reference is not used
5.3.41	Ссылка не используется	Reference is not used

№ п/п	Название документа (рус/укр)	Title of document (in English)
5.3.42	Бюллетень экологического состояния зоны отчуждения и зоны безусловного (обязательного) отселения №1(27) 2006	Ecological state bulletin of exclusion zone and Obligatory Resettlement zone. No 1 (27) 2006
5.3.43	Ссылка не используется	Reference is not used
5.3.44	Ссылка не используется	Reference is not used
5.3.45	Ссылка не используется	Reference is not used
5.3.46	Генплан точек подключения. 2005 г.	Site layout for tie-ins connection points. 2005
5.3.47	Проектирование, строительство, ввод в эксплуатацию НБК. Внутреннее распределительное устройство на 6 кВ 3606.5 – АР.2	Design, Construction, Commissioning of NSC. 6kV Indoor Switchgear Facility 3606.5 - AP.2
5.3.48	Проектирование, строительство, ввод в эксплуатацию НБК. Объединенный административный корпус малой стройбазы	Design, Construction, Commissioning of NSC. Unified Administrative Building of Malaya Stroybaza.
5.3.49	Ссылка не используется	Reference is not used
5.3.50	Ссылка не используется	Reference is not used
5.3.51	R-0476-A40624 СФЗ. Проект организации строительства, 2004	R-0476-A40624 PPS. Construction organization project, 2004
5.3.52	Требования к точкам подключения. ГУП ПОМ, 2005	Requirements for tie-ins Connection Points. SIP PMU, 2005
5.3.53	Ссылка не используется	Reference is not used
5.3.54	Проект интегрированной автоматизированной системы контроля ОУ, IAMS-OVER-GL-1001	Integrated Automated Monitoring System Technical design documentation. IAMS-OVER-GL-1001.
5.3.55	Ссылка не используется	Reference is not used
5.3.56	Ссылка не используется	Reference is not used
5.3.57	Ссылка не используется	Reference is not used
5.3.58	ППР. Монтаж оборудования и кабельных проводок. Объект «Укрытие». Блок Б. Отметки 0.00, 3.00. IAMS-OVER-GD-4609.1-R. Ред. № 03 от 07.06.07	WEP. Assembly of the equipment and cable wires. Object “Shelter”. Block B. Elevations 0.00, 3.00. IAMS-OVER-GD-4609.1-R. Rev. # 03 dated 07.06.07
5.3.59	ППР «Повышение безопасности ОУ (ремонт легкой кровли,	WEP «OS safety improvement (light roof repair, arrangement of

№ п/п	Название документа (рус/укр)	Title of document (in English)
	обустройство физзащиты на путях доступа, передача нагрузки 80%). Проект выполнения работ по Лоту 4 (ремонт легкой кровли). SIP CS A5.01 WEP-CP 001 02.595-00-04-ППР. Ред. 02 от 26.05.08»	physical protection at access ways, 80% load transfer). WEP on Lot 4 (light roof repair). SIP CS A5.01 WEP-CP 001 02. 595-00-04-ППР. Rev.02 of 26.05.08
5.3.60	ППР «Подготовка площадки под строительство НБК. Очистка, планировка территории и земляные работы под строительство фундаментов НБК. Фаза 1. Проект производства работ на демонтаж зданий и сооружений. SIP UTEM A3.01.WEP-GP 001 02.599-00-00-ППР». Ред. 02 от 08.07.08	WEP “Site preparation for NSC construction. Site clearance, territory arrangement and earth works for NSC foundations construction. Stage 1. Work Execution Package for facilities and buildings deconstruction. SIP UTEM A3.01. WEP-GP 001 02. 599-00-00-WEP”. Rev.02 dated 08.07.08
5.3.61	Документация по системе реконструкции воздуховодов ВТ-2 «Bypass». Радиологическая безопасность, SIP 03 1 003 03 RSR 001 01	Detail documentation on ”Bypass” system air duct reconstruction VS-2. Radiation safety, SIP 03 1 003 03 RSR 001 01

6. Reference documents

№ п/п	Название документа (рус/укр)	Document title (English)
6.1	Ссылка не используется	Reference is not used
6.2	Ссылка не используется	Reference is not used
6.3	Ссылка не используется	Reference is not used
6.4	Ссылка не используется	Reference is not used
6.5	Ссылка не используется	Reference is not used
6.6	Ссылка не используется	Reference is not used
6.7	Ссылка не используется	Reference is not used
6.8	Ссылка не используется	Reference is not used

№ п/п	Название документа (рус/укр)	Document title (English)
	В. Е. Хан и др. «Изучение особенностей радионуклидного состава грунтовой воды скважины 4-Г локальной зоны ОУ. Проблемы безопасности АЭС и Чернобыля», вып. 4, 2006 г.	V.Khan and others, “Study of peculiarities of radionuclide composition of the ground water of the borehole 4-Г of the SO Local zone. NPP and Chernobyl safety problems”, issue 4, 2006

7. International documents

№ п/п	Название документа (рус/укр)	Document title (English)
7.1	Ссылка не используется	Reference is not used
7.2	Ссылка не используется	Reference is not used
7.3	Ссылка не используется	Reference is not used
7.4	Ссылка не используется	Reference is not used
7.5	Ссылка не используется	Reference is not used
7.6	Ссылка не используется	Reference is not used
7.7	Ссылка не используется	Reference is not used
7.8	Ссылка не используется	Reference is not used
7.9	Ссылка не используется	Reference is not used
7.10	Ссылка не используется	Reference is not used
7.11	Ссылка не используется	Reference is not used
7.12	Ссылка не используется	Reference is not used
7.13	Ссылка не используется	Reference is not used
7.14	Ссылка не используется	Reference is not used
7.15	Ссылка не используется	Reference is not used
7.16	Ссылка не используется	Reference is not used