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**
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THE STATE SPECIALIZED ENTERPRISE "CHERNOBYL NPP"	**ГОСУДАРСТВЕННОЕ СПЕЦИАЛИЗИРОВАННОЕ ПРЕДПРИЯТИЕ "ЧЕРНОБЫЛЬСКАЯ АЭС"**
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NSC CS-1 CONCEPT DESIGN SAFETY DOCUMENT CHAPTER 1: INITIAL PROVISIONS AND FUNCTIONAL SPECIFICATIONS OF NSC CS-1	**ДОКУМЕНТ ПО БЕЗОПАСНОСТИ В РАМКАХ КОНЦЕПЦИИ ПРОЕКТА ПК-1 НБК** ГЛАВА 1 – ИСХОДНЫЕ ПОЛОЖЕНИЯ И ФУНКЦИОНАЛЬНЫЕ СПЕЦИФИКАЦИИ ПК-1 НБК
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AFAS	Automatic Fire Alarm System
ALARA	As Low As Reasonably Achievable
BAS	Baltic Altitude System
CCP	Central Control Panel
CD	Conceptual Design
CDSD	NSC CS-1 Concept Design Safety Document
ChNPP	Chernobyl Nuclear Power Plant
COP	Construction Organisation Plan
CS-1	First Commissioning Stage
CS-2	Second Commissioning Stage
DCR	Design Criteria and Requirements
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
EIA	Environmental Impact Assessment
EO	Expert Organisations
FCM	Fuel Containing Material
FS	Feasibility Study
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 Solid Radwaste management
IMSM	Integrated Management Systems Manual
IE	Initial Event
ILW	Intermediate-level Waste
ISDB	Integrated Shelter Database
ISF	Interim Storage Facility
ISO	International Organization for Standardization
NPP	Nuclear Power Plant
NSC	New Safe Confinement
NVS	New Ventilation Stack
OS	Chernobyl NPP Object Shelter

OSPU	General Sanitary Rules for Radiation Safety of Ukraine
PMU	Project Management Unit
PPE	Personal Protective Equipment
RA	Regulatory Authorities
RAW	Radioactive Waste
RMS	Radiation Monitoring System
SACS	State Architecture and Construction Supervisory (inspection body)
SAR	Safety Analysis Report
SCR	Sanitary Compliance Report
SFMS	Structures & Foundation Monitoring System
SIP	Shelter Implementation Plan
SMS	Seismic Monitoring System
SNRC	State Nuclear Regulatory Committee of Ukraine
SPZ	Sanitary Protected Zone
SRAW	Solid Radioactive Waste
SSE ChNPP	State Specialized Enterprise ChNPP
SSTC NRS	State Scientific and Technical Center for Nuclear and Radiation Safety
TD	Technical Decision
UPS	Uninterruptible Power Supply
VS-2	Ventilation Stack 2
WD	Working Design
WEP	Work Execution Plan

1.1 PREVIOUS ACTIVITIES ON DEVELOPMENT OF NSC FS (CD)

"The Shelter conversion strategy" [1] defines three main stages for the conversion of the Object Shelter (OS) into an ecologically safe system. At the 1st stage, the main measures are for the stabilisation of the existing OS. At the 2nd stage, additional protective barriers will be created – initially, a confinement, which will ensure safety for the personnel, population and environment and establish conditions necessary for further technical activities on FCM and RAW extraction (3rd stage).

The major part of the works on the first two stages of OS conversion will be carried out in compliance with the project "Chernobyl Unit 4. Shelter Implementation Plan (SIP) [2].

The works on technologies and infrastructures for FCM and long-lived RAW removal, to be implemented at the third stage, are not included in SIP tasks. However, the development of those works within the framework of SIP Tasks 19 & 20 at the conceptual level will become a foundation for their realisation in the future [1, 13].

Program resolution P10 [3], adopted by the operating organisation in 2001, defined the strategy for the creation of the confinement as a complex of building structures, systems, sections and equipment that became the starting point for development of the project and construction of the New Safe Confinement.

Document [4] established the SIP implementation order for the Shelter. In compliance with this Resolution, the NSC design stages were defined in a Feasibility Study or Conceptual Design - NSC FS (CD) -, which is designated as the first pre-design stage. The CD development had the following organisation:

- The Customer of the NSC FS (CD) was the State Specialized Enterprise Chernobyl Nuclear Power Plant (SSE ChNPP).
- Consortium (Bechtel International Systems, Electricité de France, and Battelle Memorial Institute) was NSC FS (CD) developer. The Consortium completed the works with the participation of the Ukrainian Consortium KSK (NIISK, KIEP, ISTC).
- The funds for the project were provided by EBRD on behalf of donor-countries.

NSC FS (CD) was developed in 2002-2003. After revision by the Regulatory Authorities, (RA) in compliance with acting legislation "Feasibility Study substantiation (Conceptual Design) of the confinement" [5-9,13] according to the results of State Comprehensive Examination [28], it was adopted by the Cabinet of Ministers of Ukraine No 443-r on 5 July 2004 by resolution [10].

During 2004-2007, tender procedure for NSC creation was conducted. NOVARKA developed the technical proposal based on adaptations of the Conceptual Design. This technical proposal was defined by SSE ChNPP as being substantially responsive to the Employer's requirements and in September 2007, Contract on NSC CS-1 Design, Construction and Commissioning was signed between NOVARKA (Contractor) and SSE ChNPP (Employer).

1.2 MAIN PURPOSE AND FUNCTIONALITY OF THE NSC

1.2.1 DEFINITION OF THE NSC

In compliance with the Ukrainian law: “On General Principles of Further Operation and Decommissioning of Chernobyl NPP and Transformation of Ruined Fourth Power Unit of This NPP into Ecologically Safe System” [11], “the confinement is a protection facility that includes a complex of process equipment for removal of materials that contain nuclear fuel from the destroyed ChNPP Unit 4, for RAW management and other systems designed to support its conversion into an environmentally safe system and assure the safety of workers, public, and environment”.

1.2.2 OBJECTIVES OF THE NSC CREATION

Based on the requirements of the law indicated above and according to NSC FS (CD) [5] the NSC must meet the following purposes:

- Ensure protection of workers, public, and environment from impact of nuclear and radiation hazards inherent in the existing Object Shelter (Shelter);
- Create the required conditions to support practical activities for conversion of the Shelter into an environmentally safe system including the removal of the remainder of the nuclear fuel and FCM, RAW management activities, and deconstruction/stabilization of the unstable Shelter structures.

1.2.3 GENERAL FUNCTIONAL PURPOSE OF THE NSC

In compliance with the aims indicated above in NSC FS (CD) [5], the following general functions of NSC and its main components were defined:

1. Limitation of radiation impact on population, workers and environment by established limits under NSC normal operations, violations of normal operations, emergency situations and accidents, including accidents during deconstruction of unstable structures and future management of FCM and RAW. This function will be ensured by measures of radiation protection together with the fulfilment of other functions of the safe confinement indicated below.
2. Limitation of spreading (release) of ionising radiation and the restriction of spreading of the OS residual radioactive contamination. This function will be carried out under normal operations, violations of normal operations, emergency situations and accidents.
3. Functions supporting the process (inclusive of RAW handling).

   The implementation of these functions will be carried out by implementation and operation of the systems, equipment and system components creating the conditions for safe operation and activities on OS conversion, including:

   – Conditions for dismantling/reinforcement of unstable structures,

   – Conditions for radwaste management;

   – Conditions for future extraction of FCM and RAW,

   – Conditions for removal of accumulated water in OS,

   – Conditions for NSC normal operation, including modernization of technological systems and monitoring systems, their repair and maintenance,

- Conditions for prevention of condensation moisture generation.

4. Monitoring functions.
5. Function of physical protection and access control.

These functions are detailed in section 1.4.

1.3 STRATEGY OF NSC IMPLEMENTATION (DIVISION BY COMMISSIONING STAGES)

In compliance with [4] the following designing stages of new safe confinement are defined:

- NSC FS (CD);
- Engineering documentation (Detailed Design), which is developed in two stages:
  - Design;
  - Working Documentation.

As already mentioned above, the NSC FS (CD) had been developed in 2003. Once the Contract was awarded, NOVARKA started the works on NSC CS-1 Detailed Design development.

Since NSC FS (CD) is developed for the whole facility, according to [12], Design and Working Documentation will be developed for the first commissioning stage. Propositions on division of NSC complex to further commissioning stages were presented in Section 10 [5], and they are stated in more detail in document [13] (see also Chapter 4).

Note that according to [13], the strategy of further realisation of the NSC construction project was developed and optimised from the point of view of decreasing the influence of risks on the basic schedule of designing, construction, commissioning of NSC and dismantling of OS unstable structures.

1.3.1 STAGE 1 – PREPARATORY WORKS

The First NSC Implementation Phase will cover the preliminary study required for safe and effective construction of the NSC structure. The preliminary study will be designed for three phases:

1.3.1.1 Phase 1 of Preparatory Works

The first phase of the preparatory work is based on NSC FS (CD) and has been initiated in parallel with the call for tender for the main NSC implementation. At this stage ChNPP will determine if necessary specific important design criteria not determined in the NSC FS (CD), but required for the start of detail design (in accordance with comments and proposals from Regulatory Authorities).

The following is planned or has been achieved for the first phase:

- In order to assure construction of the NSC foundations, prior partial dismantling of the berm of the “Pioneer” wall southwards from the turbine hall along line A will be required. This operation has been successfully carried out and completed in April 2008;
- In order to optimize NSC construction schedule, the NSC construction site will be cleaned up down to the acceptable radiation limits and levelled so that future NSC construction shall be carried out;
- Earthworks will be performed for the NSC foundation areas (levelling), construction sites and other facilities by implementing technologies to treat process materials (including sorting, transportation, storage at special site etc.) - contaminated soils and other materials that are extracted during this operation (including FCM).

1.3.1.2 Phase 2 – Preparation of Infrastructure for NSC Construction

In compliance with [13] in order to implement in a timely and cost effective manner, in parallel with the NSC design development, NOVARKA will develop the design and site facilities needed to assure construction of the NSC, its foundation and mobilisation to the construction site. The following facilities construction work, or reconstruction (repair), should be begun prior to the end of the NSC design finalization and approval:

- Temporary buildings and facilities for personnel (administrative and other buildings);
- Improve road structure at ChNPP for delivery of NSC equipment and materials;
- Improvement of railways and port facilities, situated at ChNPP, in Pripyat and in Chernobyl city to assist in delivery of equipment and materials for NSC;
- Training facilities (mock-ups, etc.);
- Site improvements for NSC building and construction works;
- Warehouse/Storage areas for NSC equipment and materials;

1.3.1.3 Phase 3 – Construction of New Ventilation Stack

Since NSC FS (CD) suggests deconstruction of ChNPP 2nd construction stage ventilation stack, it will be necessary to develop design documents and construct new ventilation stack (to meet needs of Unit 3, liquid and solid waste storage facility and OS) and simultaneously reconstruct existing ventilation systems and radiation monitoring system. Commissioning of new ventilation stack (NVS) will precede deconstruction of ChNPP 2nd construction stage ventilation stack. The schedules of design and construction of NVS and design and construction of NSC CS-1 (inclusive of VS-2 deconstruction) shall be coordinated by SSE ChNPP. The procedure of Contractors' interaction on these projects will be established.

1.3.2 STAGE 2 – DESIGN, MANUFACTURE, CONSTRUCTION AND COMMISSIONING OF NSC

The works on direct designing and construction of the NSC, its commissioning with completion of all necessary tests, will then be carried out (second stage of NSC project implementation).

Allocation of two NSC commissioning stages has been planned.

1.3.2.1 NSC Commissioning Stage One – Protection Construction with Process Life Support Systems and Appropriate Infrastructure

NOVARKA will carry out the works on creation of the NSC CS-1 facilities.

The scope of work for the Commissioning Stage One includes:

1. Design and construction of NSC foundations.
2. Design, manufacture, installation and sliding of the NSC structure, including the Arch, the west and east end walls, and the main cranes system (mounted on the load bearing structures of the NSC, garages etc.), performance of additional construction and assembly works related to the NSC structure after its sliding,
3. Design of overall internal NSC components, manufacture, construction (installation) of the major structures, foundations, solid isolation coating of soil areas inside NSC, platforms, areas etc. in accordance with space-planning solutions.
4. Design, manufacture, construction (installation) and commissioning of the technological, life support and monitoring systems for the NSC (including ventilation, heating, air-conditioning

and gas purification, integrated control and management including radiation monitoring, monitoring of building structures and foundations and seismic monitoring, control of process systems…), decontamination, operational RAW management, fire protection, power supply, water supply and sewage, heat supply, communication, notification, alarm, lighting and industrial TV, pipeline from the area of dust suppression to the new mobile DSS, internal transport, access and evacuation, stationary sanitary locks - will be provided by NOVARKA, portable dust suppression systems, – will be provided by another contractor) and respective facilities, structures, rooms, areas etc. for their installation. This scope of work also will include reserve of systems' capacities for deconstruction purposes and arrangement of connection points for systems' extension. As for deconstruction, the above mentioned systems will be designed so that it is sufficient to install additional (from joint points to deconstruction areas) measuring and control channels, cable lines, communications as well as equipment in the areas linked with deconstruction etc. Connection points shall be installed at convenient locations inside NSC and auxiliary building, but arrangement of connection points inside OS is not included in NOVARKA's scope of work.

5. Design, manufacture, construction (installation) and commissioning of:
   - Sites and areas for the temporary storage and preparation of contaminated deconstructed OS structures and associated RAW, its loading and transportation for transfer to the existing or newly created SSE ChNPP RAW management infrastructure (see CS-2).
   - Areas for temporary storage of packaged RAW.
6. Design, manufacture, construction (installation) and commissioning of external engineering communications in order to connect NSC life support systems to ChNPP systems.
7. Design and deconstruction of the existing VS-2 prior to NSC arch sliding into design position (after the NVS is commissioned, see above).
8. Design and arrangement of NSC site in accordance with general layout.

NOVARKA will ensure the absence of load interaction between existing and new structures and also arrange contiguity and leak tightness between them.

During development of Design documentation, NOVARKA will take into account interaction of NSC and OS in normal and accident (Shelter collapse) situations (See section 3.6).

1.3.2.2 NSC Commissioning Stage Two – Infrastructure for Deconstruction of Unstable Shelter Structures

The Commissioning Stage Two (CS-2) will include:

1. One-stage design (Working Design) of the deconstruction of Shelter unstable structures (here and hereafter deconstruction means early deconstruction and deferred deconstruction/stabilization), including:
   - Design solutions for the deconstruction of the Shelter unstable structures including those whose locations may not be covered with the main handling equipment;
   - Mountable, including the remotely controlled equipment for the main NSC handling equipment that is designed to provide, but is not limited to, the following functions: decontamination, on-spot fragmentation of the Shelter structures, coating with dust fixatives, transfer to temporary storage and initial treatment areas, collection of associated RAW in the deconstruction areas and their transportation. Other equipment needed for deconstruction.

- Equipment and systems to prepare contaminated OS dismantled structures and associated RAW, their loading, transportation and handing over to operating or newly created SSE ChNPP RAW management infrastructure;
- Pool of process vehicles and facilities to provide access to deliver workers and equipment to the work site and mobile safety systems (sanitary locks, protected cabs, other protection and shielding systems) for early deconstruction and deferred deconstruction/stabilization of unstable structures;
- Extension of process systems for life support and NSC status monitoring and, if necessary, respective buildings, rooms, areas etc. for their location, needed for deconstruction purposes and further NSC operation after deconstruction (before FCM removal).

2. Procurement, installation and commissioning of process equipment and systems for deconstruction/stabilization of unstable structures.

More detailed distribution between CS-1 and CS-2 for structures, constructions, systems, parts, equipment etc. is presented in Attachment 2 [13].

According to [13], Deconstruction design will be started in parallel with the design for Commissioning Stage One. At the initial NSC design stage, NOVARKA will develop technical specifications that will establish major initial requirements and data for deconstruction design. Design schedules of the first and second commissioning stages will be coordinated by ChNPP. Procedure for interface between the NSC commissioning stages One and Two Contractors will then be established. It will determine specific scopes of responsibilities of each contractor in order to address the parties' needs.

1.3.3 STAGE 3 – IMPLEMENTATION OF EARLY DECONSTRUCTION

In the Third Stage after the completion of Commissioning Stage Two and technological building have. been in place, as a component of Integrated RAW Management Scheme at ChNPP Industrial site, it will become possible to start the early deconstruction of the unstable Shelter structures in the scope identified at the deconstruction working (detailed) design stage. The early deconstruction, as well as the management of deconstructed structures and associated RAW using process areas located in the technological building, will be performed under SIP involving a specialised contractor.

The scope of work for early deconstruction will include:

1. Deconstruction of unstable structures (subject to early deconstruction) itself, their preparation, loading, transportation and hand over to technological facility (or other ChNPP RAW management facilities).
2. Collection of associated RAW, it preparation, transportation and hand over to ChNPP RAW management facilities.
3. Technological maintenance and repair of systems, equipment and etc. of NSC used for early deconstruction.

This scope of work is subject to detailed elaboration and clarification based on Working Design of NSC Commissioning Stage Two.

Process facility, included into the NSC in accordance with the NSC FS (CD), will be included in the general diagram of RAW management at the ChNPP and, in particular, will perform a number of functions presented in the NSC FS (CD) as functions of the NSC Process Building. SSE ChNPP shall define technical specifications for the Process Building, in particular, for unstable structures a fragmentation process. These specifications are linked with the requirements to the NSC CS-1 concerning preparation, loading, transportation and handover of

the dismantled OS structures and associated RAW to the Process Building. Creation of the Process Building shall be completed prior at the start of the early deconstruction of unstable structures; at this, any delay of the early deconstruction shall be prevented.

SIP (Task 19 and 20) envisages development of the FCM removal issues at the conceptual level. As the result of this a Strategy for development FCM removal and RAW managements will be finalised. This document will define the strategy of the NSC Implementation Stage Three, i.e. development of technologies and infrastructure for FCM removal and their treatment as HLW. After it has been commissioned, it will become possible to start the actual FCM removal. Creation of such complex is not part of the SIP tasks and therefore NSC FS (CD) does not address the associated process equipment. However, in compliance with SIP, the NSC project as well as provision for dismantling unstable structures, should also consider to a certain extent the issues of future FCM removal, therefore there is a requirement for the NSC to provide the required process space for future disposal and use by the FCM and associated RAW removal equipment and technologies.

1.4 FUNCTIONAL SPECIFICATIONS

1.4.1 IDENTIFICATION OF SYSTEMS

According to the Strategy for NSC Implementation [13], the NSC-CS1 will include the facilities, structures, systems, sites, equipment, etc. presented in the following subsections.

1.4.1.1 NSC Main facility

Once set into its design position, this facility will consist of:

- The Arch, its western and eastern end-walls;
- The Arch bases and foundations;
- Its internal and external NSC envelope (cladding and roofing), including their maintenance system;
- Structures providing junction and interface to the existing ChNPP structures;
- The hard insulating surface of the open soil areas inside the NSC;
- Structures inside NSC defining its internal arrangements (considering deconstruction) in accordance with the design volumetric-layout solutions (rooms, zones, sites, areas, access routes system, evacuation, emergency exits, etc inside the NSC);
- Sanitary locks.

1.4.1.2 Technological building

Technological building will include the following:

- Rooms, sites, etc. allowing the operation of NSC life-support and state monitoring systems;
- Central control panel (CCP);
- Room for the access control and physical protection equipment;
- Rooms for ventilation system including the filter room;
- Sanitary locks;
- Shops for technical maintenance and repair of equipment;
- Shop for equipment decontamination;
- Radiation control shop;
- Office rooms;
- Facilities for the LRAW management system, forced ventilation of the Arch space and annular space (these facilities may be designed separately from the Technological building).

It should be noted that the Technological building does not include the treatment areas for OS disassembled structures, envisaged in the NSC FS (CD). These areas will be partially located inside the NSC and partially in the separate technological building, which will be integrated into the general ChNPP scheme for radioactive waste management.

1.4.1.3 Auxiliary buildings and facilities, utilities

This system consists of:

- Buildings and facilities for the accommodation and operation of NSC life-support systems, which are not included in the Technological building (sewage pump station, power supply, fire-fighting systems building, dust suppression system facility, etc);
- NSC offsite utilities (up to the points of tie-in to ChNPP utilities);
- Infrastructure buildings and facilities within NSC site (taking into account deconstruction);
- Hard surface and NSC site arrangement;
- Other facilities.

1.4.1.4 Power supply system

This system consists of:

- All necessary equipment considering the needs of both commissioning stages;
- Electrical power supply to CS-1 consumers;
- Lighting of CS-1 consumers, emergency and evacuation lighting;
- Points for the tie-in of CS-2 consumers;
- Protective grounding system;
- Lightning protection system;

This system will be integrated together with the OS and ChNPP systems.

1.4.1.5 Communication, alarm and warning system

This system consists of:

- All necessary equipment considering needs of both commissioning stages and arrangement of corresponding facilities and sites;
- Installation of communications, alarms and warning for CS-1;
- Tie-in points for CS-2;

This system will be integrated together with the OS and ChNPP systems.

1.4.1.6 Industrial television system

This system consists of:

- All necessary equipment considering the needs of both commissioning stages and arrangement of corresponding facilities and sites;
- Installation of industrial television facilities for CS-1;
- Tie-in points for CS-2.

This system will be integrated together with the OS and ChNPP systems.

1.4.1.7 Ventilation, gas purification and conditioning systems

This system consists of:

- System of arch space plenum-exhaust ventilation aimed at the prevention of condensate generation, and as needed creation of required temperature and humidity environment with radiological monitoring of releases;

- Ventilation system for prevention of contamination spread during opening of northern gates and southern air-lock;
- Plenum-exhaust ventilation of circular inter-arch space and conditioners for plenum air heating;
- Technological building ventilation system, including plenum-exhaust ventilation of subzone 1 and 2 rooms (air-locks, maintenance shops, decontamination and repair shops, sanitary locks, etc); central control room, offices, water closets; other rooms and areas (considering needs of both commissioning stages);
- Upgrade air intake and release parts of the existing ventilation system of Deaerator Stack rooms to make them independent of atmosphere and NSC arch space ventilation;
- Ventilation system of NSC internal arrangement rooms for CS-1, back-up equipment and hook-up points for CS-2;
- Ventilation systems of auxiliary buildings and facilities for CS-1, back-up equipment and hook-up points for CS-2;
- Provision of gas purification in CS-1 ventilation systems in accordance with sanitary rules, and back-up equipment and hook-up points for CS-2;
- Provision of air conditioning at CS-1 workplaces in accordance with sanitary rules, and back-up equipment and hook-up points for CS-2.

The system shall be integrated with the existing ventilation systems of the Object Shelter.

Upon commissioning of this system NOVARKA shall facilitate the isolation of SO ventilation from NSC ventilation. The procedure of NVS disconnection shall be described in the NSC CS-1 Commissioning Program.

1.4.1.8 Unified industrial and potable water supply system

This system consists of:

- All necessary equipment considering the needs of both commissioning stages and arrangement of corresponding facilities and sites;
- Industrial and potable water supply of CS-1;
- Tie-in points for CS-2;

This system will be integrated together with the OS and ChNPP systems.

1.4.1.9 Firewater supply system

This system consists of:

- All necessary equipment considering the needs of both commissioning stages and arrangement of corresponding facilities and sites;
- NSC firewater supply for CS-1,
- Tie-in points for CS-2 ;

1.4.1.10 Heat supply system

This system consists of:

- All necessary equipment considering needs of both commissioning stages and arrangement of corresponding facilities and sites;

- Hot-water heating of the first commissioning stage;
- Tie-in points to the hot-water heating system for CS-2;

This system will be integrated together with the OS and ChNPP systems.

1.4.1.11 Sanitary sewage system

This system consists of:

- All necessary equipment considering the needs of both commissioning stages and arrangement of corresponding facilities and sites;
- Sanitary sewage for both commissioning stages;
- Hook-up points to the sewage collection system for CS-2 (as required, if it will be impossible to fully execute the previous item).

This system will be integrated together with the OS and ChNPP systems.

1.4.1.12 Industrial sewage system

This system consists of:

- All necessary equipment considering the needs of both commissioning stages and arrangement of corresponding facilities and sites;
- Industrial sewage system for CS-1 and stationary places of floor water collection for CS-2;
- Tie-in points to the system of sewage collection from the mobile (as required, stationary) collection facilities for CS-2;

This system will be integrated together with the OS and ChNPP systems.

1.4.1.13 Storm sewage system

This system consists of:

- Main equipment (system of water discharge pipes and channels from the NSC roof, existing OS structures protruding beyond arch boundaries as well as the other NSC buildings and facilities; system for collection of rain and melted water (including one from the NSC site), main pipes and channels to the place of storm sewage discharge (as required, pump and purifying equipment, etc));
- Storm sewage for both commissioning stages;
- Tie-in points to the storm sewage system for CS-2 (as required, if it will be impossible to fully execute the previous item).

This system will be integrated together with the OS and ChNPP systems.

1.4.1.14 Liquid radioactive waste (LRAW) system

This system consists of:

- All necessary equipment considering the needs of both commissioning stages and arrangement of corresponding facilities and sites;
- LRAW collection system (special sewage) and portable equipment for CS-1 and stationary locations of LRAW collection for CS-2;

- Tie-in points to the system of LRAW collection using mobile (as required, stationary) LRAW collection facilities for CS-2.

This system will be integrated together with the OS and ChNPP systems.

1.4.1.15 Decontamination system

This system consists of:

- Equipment for the needs of CS-1 and partially of CS-2 and arrangement of corresponding facilities and sites. The shop for equipment and tools for decontamination shall be suitably equipped to take into account the needs for decontamination of portable equipment (e.g. devices, grippers, scaffolding, tools, etc), which will be used during deconstruction. Appropriate equipment will also be provided for the decontamination of cranes, vehicles and personal/collective protective equipment. The CS-1 scope does not include equipment for decontamination of dismantled structures and main equipment (specifically for deconstruction), which is going to be decontaminated directly within specifically defined areas. These areas include those concerned with deconstruction, pre-processing of collected of encountered RAW and preparation of dismantled structures and RAW for transportation to other ChNPP facilities. In addition, the scope does not include special mechanisms for loading and transportation of deconstructed structures and RAW. The CS-1 decontamination network shall, as far as possible, consider decontamination of preparation and loading areas including:
- Decontamination system for CS-1;
- Tie-in points for CS-2.

This system will be integrated together with the OS and ChNPP systems.

1.4.1.16 Personnel sanitary treatment system

This system consists of:

- Sanitary locks at the NSC boundaries, within technological building and inside the NSC for both commissioning stages;
- Mobile sanitary locks for CS-1.

1.4.1.17 Dust suppression system

This system consists of:

- New plant for the preparation and supply of existing DSS mixtures (as required, if existing plant will have to be deconstructed);
- Arrangement of the mixture preparation area and pipeline from this area to the new mobile DSS.

As per the current plans, the existing site for DSS mixture preparation will not be deconstructed.

1.4.1.18 Fire protection system

This system consists of:

- Automatic fire alarm system (AFAS): main equipment (main control station equipment, fire detector network and control network equipment, cabling, other technical facilities; arrangement of respective rooms and facilities, etc) considering needs of both commissioning stages; installation of AFAS for CS-1 ; hook-up points for CS-2;

- Fire warning system (including warning by the fire department) and evacuation control;
- Automatic fire-fighting system for CS-1, back-up equipment and hook-up points for CS-2;
- Firewater supply system;
- Smoke protection and ventilation system considering needs of both commissioning stages (should CS-2 needs not be fully considered, respective hook-up points shall be provided);
- Primary fire-fighting facilities considering needs of CS-1, and partially needs of CS-2;

This system will be integrated together with the OS and ChNPP systems.

1.4.1.19 NSC Integrated Control System

This system consists of:

- Integrated control system (upper level): main equipment (arrangement of the central and local control panels (except for local control panels, which directly control technological process of deconstruction), computer, network and other hardware, software, etc) considering needs of CS-l;
- Performance of integrated control of CS-1;
- Back-up equipment and hook-up points for CS-2;
- Seismic monitoring system;
- NSC structural monitoring system;
- Radiological monitoring system:
- Equipment considering the needs of both commissioning stages;
- Assurance of radiological monitoring for CS-1, hook-up points for additional measurement channels to CS-2;
- Main handling mechanisms control system;
- Control of the other NSC systems (CS-1, considering needs of CS-2).

This system will be integrated together with the OS and ChNPP systems.

1.4.1.20 Solid radioactive waste (SRAW) management system

This system consists of:

- Equipment for collection, preliminary sorting, containerization, loading and transportation of low- and medium-level operation (initial and secondary) SRAW to the other ChNPP facilities;
- Equipment for collection, containerization, loading and transportation of high-level operation SRAW in case of its detection.

This system will be integrated together with the OS and ChNPP systems.

1.4.1.21 Crane and transportation equipment inside the NSC

This component consists of:

- Main crane system, including systems of monitoring and control, power supply, maintenance garages, rooms for storage of crane trolleys, devices for fixation of attached equipment, etc, special trolley with telescopic mast;
- Equipment for transportation and loading of CS-1 and CS-2 operational RAW;

- Equipment for delivery of cargo and personnel to workplaces (elevators, trolleys, access routes, staircases, etc) for CS-1 and partially for CS-2.

1.4.1.22 Areas and equipment for remote deconstruction of unstable structures

This component consists of:

- Main cranes' system (see above);
- Areas and facilities to lay down (and store) equipment and to perform dismantlement (within NSC internal arrangement);
- Tie-in points for life supporting and status monitoring systems.

1.4.1.23 Areas and equipment for initial treatment

This component consists of:

- Facility walls and roof with an aperture to receive dismantled structures, equipped with biological protection;
- Space to lay rail tracks for 15-ton trolleys;
- Space to lay rail tracks for 20-ton semi-gantry crane from tracks in trucks loading area;
- Roofs local reinforcement in loading area and under main crane trolleys maintenance garage;
- Tie-in points for NSC life supporting and status monitoring systems.

1.4.1.24 Preparation area

This component consists of:

- Space to lay rail tracks for 15-ton trolleys;
- Space for rail tracks for 20-ton semi-gantry crane to cover entire area from tracks in trucks loading area;
- Foundations for biological protection walls around radiation zone 2;
- Facility walls and roof;
- Tie-in points for NSC life supporting and status monitoring systems.

1.4.1.25 Temporary storage area and southern airlock for large trucks

This component consists of:

- Arrangement of temporary storage area, including its equipping with all necessary life supporting and status monitoring systems;
- Southern sliding gates of the western end wall with a control panel;
- Materials and equipment air lock equipped with all necessary life supporting and status monitoring systems;
- Creating necessary conditions to further extend systems including but not limited to decontamination, liquid RAW collection, mobile shielding, and local ventilation.

1.4.1.26 Truck loading area, guard houses (KPP) and Northern gates for standard vehicles

This component consists of:

- Gates for standard vehicles;
- Internal air lock;
- Radwaste and trucks exit monitoring point;
- Crane (20 tons) with control system and rail tracks to initial treatment area border;
- Ventilation systems to contain contamination within arch limits during opening of gates.
- Other life supporting and status monitoring systems.

1.4.1.27 Packaged RAW temporary storage area

This component consists of areas for the buffer storage of containers based on data from NSC FS (CD).

1.4.1.28 Physical protection and access control system (PP&AS)

This system consists of doors equipped with sensors and locks positioned on the access ways to the sites, areas and equipment the access to which shall be limited.

This system will be integrated into existing ChNPP PP&AS system created by another contractor under SIP programme.

1.4.1.29 Technical means to ensure NSC personnel safety

This system consists of mobile equipment, instruments, individual and collective protection equipment etc. that is necessary to ensure NSC personnel safety (radiation safety, emergency planning, fire safety, technical safety) for commissioning stage 1 and partially for commissioning stage 2.

1.4.2 FUNCTIONAL SPECIFICATIONS

1.4.2.1 NSC Main facility

1.4.2.1.1 <u>NSC main protective facility</u>

The NSC main protective facility consists of an arch-shaped structure of western and eastern end-walls, foundations, internal and external skins (including their maintenance system), structures ensuring adjoining with the existing structures, and solid insulating coating of the open soil inside NSC.

The NSC main protective facility has the following functional purpose:

- to prevent and limit the spreading of radioactive substances located in SO beyond the NSC limits in such a way that the protection of personnel, public and environment beyond the NSC limits will be guaranteed;
- To prevent the penetration of atmospheric precipitation inside the NSC and accordingly inside the SO;
- To prevent (if impossible, to limit) the unauthorised discharges of radioactive substances through the soil inside NSC;

- To create the necessary technological space and conditions for location of systems and components performing the practical activity of SO conversion into an ecologically safe system;
- To create conditions for circulation of equipment and personnel inside NSC;
- To create conditions for technical maintenance and repair of this facility.

This includes provision for the dismantling/strengthening of unstable SO structures, removal of remaining nuclear fuel and FCM, implementation of works on RAW handling.

The NSC main protective facility shall fulfil these functions while meeting the design criteria and requirements stated in Chapter 2 of this document.

1.4.2.1.2 Solid insulating coating of the open soil inside NSC

The soil inside the NSC will be covered by a solid insulating surface that allows for prevention releases of radioactive materials through the soil to the water table. This surface will also ensure safe conditions for the works and for the internal transportation equipment such as forklifts or trolleys.

Locally, the solid insulating surface will also enable easy cleaning to avoid fixation of dusts and contamination and thus limit the dose rates in areas where personnel attendance is likely.

1.4.2.1.3 Internal arrangement of NSC

The structures of the internal NSC arrangement shall fulfil the following functions (depending on their specific purpose) to create the conditions for:

- Placement of systems and equipment to realise the practical activity on SO conversion into an ecologically safe system, including the activity related to the dismantling of unstable structures and their handling together with RAW;
- Circulation of mechanisms, and personnel (including access and evacuation) inside NSC);
- Facilitation of the safety at work places (in particular shielding, limitation of radioactive substances' spreading).

These functions shall be fulfilled while meeting the DCR stated in Chapter 2.

1.4.2.1.4 Sanitary locks

Personnel, access to and exit from the NSC will be performed via a stationary sanitary lock located in the Technological building. Stationary or portable (temporary) sanitary locks will be located at the boundary between zones 3 and 2, and between zones 2 and 1 working rooms. The placement of sanitary lock placement is conditioned by the likelihood or potentiality of radioactive contamination on the surfaces and therefore by the necessity to wear additional PPE for the work in the above mentioned zones.

Sanitary locks shall fulfil functions presented in Section 1.4.2.16 meeting the DCR stated in Chapter 2 of this document.

1.4.2.2 Technological building

The main functions of the Technological building are:

- Facilitation of the necessary conditions for placement of process systems and life-supporting systems, as well as NSC control and management;

- Confinement: prevention and limitation of unauthorised releases and discharges, prevention and limitation of the spreading of radioactive materials (dusts, liquids and solids) from the more contaminated areas to the less contaminated ones. The technological building will include all provisions to keep contamination in rooms of personnel attendance (permanent and temporary) above the levels defined in the Applicable documentations [16];
- Personnel protection from ionising radiation: through its internal arrangements and the design of the thickness of its walls (inner and outer), the technological building will ensure that the dose rates in the rooms of personnel attendance (permanent and temporary) meet the respective criteria [16]. This approach also allows limiting unauthorised circulation of personnel and goods as far as achievable in the technological building.
- Facilitation of radiation and hygienic zoning of the rooms, access ways to NSC and evacuation routes;
- To provide for the necessary room for safe equipment maintenance and repair, and decontamination of equipment and tools;
- To provide the necessary room for the Central Control Panel and rooms for NSC system installation;
- Appropriate working conditions for personnel: the technological building will encompass all services to allow appropriate working conditions for personnel with specific heating system (ventilation), sanitary facilities, offices, airlock and restrooms.

These functions shall be fulfilled while meeting the DCR stated in Chapter 2 of this document.

The Technological building will be located directly at the western end wall of NSC. The Technological building will accommodate:

- Rooms, sites, etc. providing the operation of life-supporting and state control systems of NSC;
- Central Control Panel (CCP) and rooms for placement of control cabinets of control and life-supporting systems;
- Room for equipment of access control and physical protection;
- Rooms for ventilation system, including filter room;
- Sanitary locks;
- Rooms for placement of sanitary and industrial sewage systems;
- Equipment technical maintenance and repair shops;
- Equipment decontamination shop;
- Radiation monitoring shop;
- Office rooms
- Facilities for systems of LRW handling, plenum of the arch space and circular space (these facilities may be designed separately from the Technological building).

Functions of the systems to be located in the Technological building are described in appropriate sections.

1.4.2.3 Auxiliary buildings and facilities, utilities

The auxiliary buildings and facilities, and utilities will perform the following functions:

- Provision for appropriate working conditions for personnel and equipment located in these facilities. The buildings will be equipped with all the systems to facilitate the appropriate conditions for the personnel and equipment: special heating and ventilation systems, sanitary facilities, offices and sanitary locks, etc.;
- Facilitation of connection of the engineering and technological systems of NSC to the tie-in points for utility supply;
- Prevention and limitation of unauthorised discharges of radioactive materials into the environment with the help of solid coating and arrangement of NSC site with establishment of the storm sewage system.

These functions shall be fulfilled meeting the DCR stated in Chapter 2 of this document.

The auxiliary buildings and facilities, utilities will be located on NSC site, and if necessary inside NSC, and will accommodate the following:

- Buildings and facilities for location and operation of the NSC life-supporting systems not included into the Technological building (sewage pump station, NSC and site shower sewage system, building for systems of power supply, fire-fighting, facility for dust-suppression system, etc.;
- Off-site engineering utilities of NSC (to the tie-in points to ChNPP systems);
- Buildings and facilities of infrastructure on NSC site;
- Solid coating and arrangement of NSC site, including transportation ways and passages, connection of existing transportation ways with Arch and auxiliary facilities of confinement entrances, including the pavements, access via the access control points and emergency parking lots close to the NSC Arch and auxiliary facilities entrances;
- Other facilities and buildings, the necessity of which shall be determined during the design.

The functions of systems to be places in the Auxiliary buildings and facilities are described in appropriate sections.

1.4.2.4 Power Supply System

The power supply systems shall fulfil the following functions:

- Supply to all NSC consumers of necessary reliable power for their operation depending on their category and safety classification;
- Lighting (including emergency and evacuation) of rooms, sites, zones, etc. inside NSC, in technological building, in auxiliary buildings and facilities and on NSC site;
- Protective ground of all NSC components;
- Lightning-protection of NSC and auxiliary facilities on NSC site.

These functions shall be fulfilled while meeting the DCR stated in Chapter 2 of this document.

1.4.2.5 Communication, alarm and warning system

Communication, alarm and warning system will perform the following functions:

- facilitation of communication between the personnel for the exchange of the needed information when performing the technology processes, works and operations;
- Alarming of the occurred violations of the normal operation, all the emergency situations and accidents;

- Notification to the personnel on the necessary actions under all emergency situations and accidents.

These functions shall be fulfilled meeting the DCR stated in Chapter 2 of this document.

1.4.2.6 Industrial television system

The industrial television system will perform the functions of the visual control during operations and works implementation:

- on remote control of mechanisms and technology processes;
- With presence of the personnel inside the NSC main protective facility.

These functions shall be fulfilled meeting the DCR stated in Chapter 2 of this document.

1.4.2.7 Ventilation, gas purification and conditioning system

1.4.2.7.1 General provisions

The main functions of the ventilation, gas purification and conditioning (VGPC) systems:

- Confine contamination by assuring that airflow is always from areas of lower potential for contamination towards areas of higher potential for contamination;
- Maintain the emissions to the environment within limits set forth in Chapter 2 of this document;
- Provide a controlled environment (temperature, humidity and cleanliness) for personnel comfort and safety, and for the proper operation of equipment in compliance with BSRU requirements and taking into account the use of individual security facilities (ISF) and individual security facilities respiratory apparatus (ISFRA) where appropriate;
- Prevent the spread of smoke and products of combustion in the event of a fire.
- Prevent generation of flammable and explosive vapours, gases and dust mixtures in excess of established values.

In accordance with these functions the VGPC are required to:

- Direct airflows from the potentially less contaminated areas to the potentially highly contaminated areas;
- Ensure that airborne particulate level conforms to the requirements set forth in Chapter 2 of this document;
- Ensure that releases into the environment are below the limits set forth in Chapter 2 of this document;
- Ensure minimum allowable supplied airflow speed in order to avoid the raising and transport of dust;
- Provide controlled environment (temperature, humidity and cleanliness) for personnel comfort and safety, and for the proper operation of equipment in enclosed spaces of the Technological building and the NSC arch;
- Prevent generation of inflammable and explosive fumes, gases and dust, and their exceeding the established limits;
- Prevent smoke and burning products spreading in case of fire and ensure smoke removal if necessary;

- Ensure that humidity level conforms to the design limits established for longevity of the arch main structures (the Contractor shall establish these limits taking into account the requirement for minimization of NSC maintenance);
- Ensure prevention of condensation (creation of liquid RAW) inside the arch;
- Support optimum conditions for the operation of technological equipment.

The ventilation system will be split into the subsystems which are described in the following subsections.

All ventilation, gas purification and conditioning systems shall fulfil functions meeting DCR stated in Chapter 2 of this document.

1.4.2.7.2 Main volume ventilation system

The main volume ventilation system has to perform the following functions:

- The airflow direction is maintained from areas of lower radiological contamination to areas of potentially higher radiological contamination;
- Minimum necessary speeds of inlet air flows are ensured in order to prevent the dust suspension and transfer;
- There is no condensation on inner skin of arch per DCR stated in Chapter 2 of this documents;
- The decreased air pressure is created and monitored in comparison with the external environment and annular space in order to prevent the radioactive substances release;
- The radioactive releases to environment are kept within acceptable limits stated in Chapter 2 of this document.

1.4.2.7.3 Annular space ventilation system

The ventilation of the annular space has to perform the following functions:

- Hygrometry control to avoid steel arch and cladding corrosion;
- Temperature facilitation aiming at prevention of the condensate creation per DCR state in Chapter 2 of this document;
- Increased air pressure compared to the main volume and consequently to the exterior, in order to avoid water (mist) ingress from outside and dust ingress from the main volume.

1.4.2.7.4 Ventilation system of the Technical buildings and facilities

The NSC buildings and premises will be equipped with sufficient local systems that may be integrated into the general one.

Appropriateness of such integration will be specified in the Design with consideration for benefit and cost analysis.

During the design of such systems the following provisions will be addressed:

- A particular temperature shall be maintained within each semi-attended area and areas permanently occupied by personnel. Specific temperature of each area will depend upon type of works performed within this area;
- Air filtering systems shall be installed, as necessary, enabling the removal of increased dust level and radioactive contamination at the areas occupied by personnel. (See note below);

- Prevention of air flow going from contaminated areas to relatively cleaner ones;
- Provision of air locks between areas with different contamination levels;
- Maintenance of temperature, humidity and cleanliness at the central control panel (CCP) as well as premises allocating automated control equipment;
- Provision of local exhaust system within areas, where generation of dust and smoke is expected. (See note below);
- Installation of heaters if heating is required for specific CS-1 technical maintenance operations;
- Preventing generation of inflammable and explosive vapour, gases and dust mixtures in amounts exceeding the established ones;
- Ensuring smoke exhaust from attended areas and evacuation routes;
- Classification of premises by zones based on the kind of activities and expected levels of contamination during the activities performance;
- Ensuring control and automation of ventilation, gas purification, and air conditioning system from CCP and in-situ (as necessary).

Note: Equipment to deal with exhaust from equipment provided by the NSC CS-2 Contractor (e.g., local filters, or ducting to exhaust plenums) will be made accessible through hook-up points.

1.4.2.7.5 Ventilation systems at north and south gates air locks opening

The main purpose of these systems is to prevent environment pollution by means of directing air flow from the outside of NSC to NSC air curtain or air lock.

1.4.2.7.6 Exhaust ventilation systems of decontamination, equipment technical maintenance and repair shops, «dirty» sanitary locks areas located in the Technological building

The main functions of these systems are:

- Restriction of releases to the environment, in accordance with criteria and requirements specified in Chapter 2 of this document;
- Restriction of contamination spread by directing air flow from the areas with lower potential contamination to the area with higher potential contamination (for the premises adjacent with the area 1 premises, NSC sub-arch space as well as premises with higher reference levels of air contamination);
- Restriction of contamination spread by local air aspiration at work places, where dust raising and airborne particles generation are possible.

Number of ventilation units is determined by the premises category, by radiation and fire safety as well as by premises composition.

1.4.2.7.7 Ventilation systems of offices, access control points, break rooms, WC, rooms for “clean” sanitary lock equipment storage, radiation safety shop, etc., located in the Technological building.

The main purpose of the systems is to provide controlled environment (temperature, humidity and clearness) for better comfort and safety of personnel and appropriate operation of equipment. Prevention of contamination penetrating from outside is covered, for example, by the use of pressurized air conditioning system.

It is anticipated that the ventilation systems of offices, access control points, recreation rooms, WC, rooms for storing “clean” sanitary lock equipment, radiation safety shop, etc., belong to zone 3.

For heating purposes and air curtains in the transportation exits, recirculation units are acceptable.

1.4.2.7.8 Ventilation systems of electric switchboard and central control panel premises located in the Technological building

The main function of the given systems is to provide controlled environment (temperature, humidity and clearness) for better comfort and safety of personnel and appropriate operation of equipment.

It is anticipated that electric Switchboard and Control Panel premises are related to zone 3.

Independent input ventilation systems with purification using airborne particulate filters are envisaged for control rooms in case of outdoor air contamination. Pressurized air conditioning systems are envisaged.

1.4.2.7.9 Ventilation systems of NSC internal arrangement facilities

The main functions of this system are the following:

- Limitation of releases into the environment meeting the DCR stated in Chapter 2 of this document;
- Facilitation of the controlled ambient medium (temperature, humidity and cleanliness) for comfort and safety of the personnel, for the due operation of equipment;
- Limitation of the airborne contamination spread by way of air flow direction from the zones with lower potential contamination into the zones with higher potential contamination (for the rooms adjacent to rooms of zone 1, to main space of NSC, and rooms with higher admissible levels of air contamination);
- Limitation of contamination spread by means of local air removal from the working places where the dust suspension and aerosol creation is possible.

The number of the ventilation installations shall be defined by the category of the room, site, etc, related to the radiation and fire safety, and arrangement of the rooms.

1.4.2.7.10 Deaerator stack rooms existing ventilation system upgrade

The basic functions of this system is the facilitation of independence from the atmosphere and ventilation of the NSC arch space of air inlet and release of the existing ventilation systems of the deaerator stack rooms.

1.4.2.7.11 Systems of exhaust and input ventilation of rooms of exhaust ventilation filters located in the Technological building

The basic functions of these systems are:

- Limitation of release into the environment meeting the DCR stated in Chapter 2 of this document;
- Facilitation of the controlled conditions of the environment for the operation of the equipment;
- Limitation of air contamination spread by means of air flow direction from the zones with lower potential contamination into the zones with higher potential contamination.

1.4.2.8 Combined industrial and potable water supply system

The combined industrial and potable water system will provide water at the various workplaces with industrial water for process equipment and potable water for personnel consumption in sanitary areas. The main industrial water consumers are:

- The ventilation system (chillers, heaters);
- The decontamination system;
- The systems used to clean the working areas and offices, other consumers in the third sanitary and hygienic are;
- The water-coolers of some heat-generating apparels;
- The waste assay laboratory;
- Other systems using water.

The main potable water consumers are:

- The sanitary lock for personnel access;
- The lavatories and showers.

Additional hook-ups will be provided in the areas covered by the CS-2 systems such as the preparation area or the preliminary processing area, and other sites and areas.
This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.9 Firewater supply system

The functions of the fire fighting water supply system are:

- Fire fighting water intake;
- Fire fighting water transportation;
- Water reserve for fire fighting in the events specified in the norms;
- Ensuring fire fighting with water.

The fire fighting water supply system is divided in two subsystems:

- External fire fighting water supply;
- Internal fire fighting water supply.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.10 Heat supply system

The heat supply system is to provide water of the appropriate temperature to the following equipment:

- Heating, Ventilation and Air conditioning system;
- Decontamination system;
- Any other system that might require heating functions.

The following functions of the system will be considered in the project of heat supply system:

- Provision of normal conditions for the personnel work;
- Possibility of keeping the necessary temperature in separate technological rooms of NSC in the limits of technological and calculated parameters;

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

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.11 Sanitary sewage system

The sanitary sewage system will collect sanitary water from both commissioning stage. Water from showers and washbasins will be segregated depending on its origin: water collected downstream the sanitary airlock will be considered as waste requiring assay.

The installation of the domestic sewage system components in areas of potential radioactive contamination of effluents is not foreseen.

The sewage of the domestic water from the toilets will discharge to a pump station and further to the domestic sewage system of the ChNPP site.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.12 Industrial sewage system

The industrial sewage system aims to collect waters produced in the working rooms of the NSC facility and in the technological and auxiliary buildings. Waters will be collected by sumps or pumping and will be transferred via pipelines to the ChNPP site industrial sewage or storm water treatment system with organization of radiation monitoring. Mostly the skimming of oil from the sumps is required. The measures to prevent the system from radioactive media will be foreseen.

The industrial system will be separated from the LRAW management system in such a way radioactive materials are not collected there. If required, samples can be taken on-line to guarantee efficiency of this segregation.

Because of this requirement, the industrial sewage system will not be implemented in the areas potentially contaminated.

A branch of the industrial sewage system will also be available from the annular space of the NSC in order to receive and collect the unlikely drips or condensate that might be produced there.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.13 Storm sewage system

The storm sewage system allows for managing the climatic water in order to avoid it from damaging the outer surfaces and structures of the NSC and to penetrate it. It will collect and transfer storm, rain and smelted snow flowing from the roof of:

- The Main NSC facility;
- The auxiliary buildings and the technological building;
- Structures of the existing OS forming the NSC envelope i.e. protruding parts of the turbine hall and deaerator stack and the block V;
- Roads and facilities connected to the NSC located on NSC site.

The storm water from-on the NSC Arch will be transferred to the existing water transfer canal located south of the NSC via dedicated pipelines.

The storm water from NSC site shall be performed to the existing water transfer canal located south of the NSC with the previous purification mainly from mechanical admixtures and possible oil products. The radiation monitoring of the transferred water shall be foreseen.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.14 Liquid waste management system

At a conceptual level, the forecasts on the generation of operational liquid radioactive waste inside the NSC are:

- Usage of water dust suppression solutions;
- Usage of water decontaminating solutions;
- Usage of water from the fire-fighting system;
- Possible application of liquids during deconstruction and primary treatment of unstable Shelter structures;
- Sanitary treatment of personnel.

The Liquid radioactive waste (LRAW) management system aims to collect those liquids produced in the areas of the NSC and Technological Building where contamination is potential. It will collect the primary and secondary LRAW and will ensure storage and transfer to the LRAW management system of ChNPP.

In this framework, the LRAW management system performs a containment function and therefore aims to protect personnel public and environment from radiation. It entails prevention of spreading of liquids in areas which are not intended to be contaminated and allows for optimisation of volumes.

The LRAW management system will also allow waste assay' before transfer to the ChNPP management system as it is described in section 3.8.2 of the CDSD. This includes provision on an interim storage tank for waste storage and transfer to the dedicated stream.

The LRAW management system will encompass sumps located in appropriate low-points of all the rooms potentially contaminated. These sumps will be connected to an interim storage tank via pipelines located, as far as achievable, in galleries fitted with drip-trays to collect potential leaks.

As part of the LRAW management system, sumps will be included in the NSC main volume to collect all potential waters produced there, including the potential condensates that might be produced under violations of normal operation.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.15 Decontamination system

The decontamination system aims to decrease the potential contamination of tools, systems and surfaces in order to reduce the exposure rates during normal operation, maintenance and intervention.

The surface decontamination system will allow for removing the contamination from the structures and walls contaminated by dust suspension inclusive of accidental one. No decontamination will be carried out in normal operation or maintenance on the main arch structure and on the OS external surfaces. Nevertheless, the decontamination system will cover the cladding in order to avoid dust deposits and accumulation on it.

The decontamination system will also concern the lifting equipment (main cranes, cranes in the preparatory areas) and the transportation means which will be used for both NSC CS-1 and CS-

2 activities. The decontamination of main cranes and trolleys will be carried out in a dedicated crane park in order to circumscribe the spreading of contamination and to ensure adequate working conditions for decontamination personnel. The operations on the other lifting mechanisms will be carried out either in a dedicated decontamination room in the Technological Building or in temporary enclosures (tents) which will be purpose-implemented locally.

The decontamination system hence includes a dedicated room isolated from the rest of the building which will be fitted by all provisions to reduce spreading of radioactive materials either airborne or waterborne to the environment.

The selection of decontamination processes will be made with regards to their adequacy to the materials to be treated and to the contamination form, and also with regards to their environmental impact and the dosimetry associated with their implementation. As far as achievable dry decontamination processes will be selected in priority (for instance vacuuming, brushing) in order to limit the effluent production and keep the environmental impact the lowest practicable.

Rooms where liquid decontamination will be required in the frame of NSC CS-1 or CS-2 activities (for instance the decontamination room, the crane park, the initial treatment area, the preparation area), will be supplied with specific solutions prepared in a dedicated workshop inside the Technological Building. Those rooms will be connected via a sump to the LRAW management system.

The decontamination solutions will be selected according to their adequacy to the operations, with regards to the applicable norms like OSPU and considering ChNPP's waste acceptance criteria. It has to be borne in mind that in order to prevent corrosion of the treated surfaces and of the discharge pipelines, the decontamination solution will be chemically neutralised before exhaust.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.16 Personnel sanitary treatment system

The personnel sanitary treatment system is composed of a fixed sanitary lock located inside the Technological building and mobile sanitary locks which can be installed anywhere inside the Main NSC facility and technological building for specific operations. The main sanitary lock aims to:

- Control and register personnel access to the rooms potentially contaminated and therefore prevent unauthorised access there;
- Equip personnel with additional protection clothing and other means (called personnel protection equipment);
- Equip personnel with portable radiation monitors (dose rate and contamination) to prevent and avoid unjustified exposures to radiation;
- Monitor personnel when exiting the sanitary lock to check their external non contamination and avoid contamination from spreading out inside the auxiliary building;
- Decontaminate the belongings and the outfits of personnel;

The following shall be included into sanitary lock:

- Places for clothes changing and storing on shelves or in wardrobes of additional PPE like pneumatic suits, coats, aprons, over-sleeves, gloves, shoes, shoe covers, respirators);
- Device for preliminary cleaning of the special shoes' soles for the workers (sanitary trays);
- Place with the disciplinary barriers for replacement of additional special shoes equipped with shelves;

- Site for the preliminary washing (decontamination) of pneumatic suits directly on the person before doffing;
- The site for collection of the contaminated special clothes, PPE, equipped with benches and containers for collection and transportation of the clothes into the special laundry, site for decontamination of additional PPE made of PVC film, rubber and rubber clothes;
- Point of radiation monitoring equipped with the means of radiation control;
- Wash-stands with hot and cold water supply, and tanks with decontamination solutions for hand washing; site for changing of basic special clothes in case of its contamination exceeding the reference levels.

The details of sanitary locks are defined in Chapter 2 of this document.

The mobile sanitary locks will be installed locally for operations requiring additional containment and personnel access control.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.17 Dust suppression system

The dust suppression system aims to prevent dusts from suspending inside the Shelter and therefore inside the NSC. It aims thus to limit releases of effluents to environment and to reduce the exposure of personnel working inside the main NSC facility.

As mentioned above in this chapter, the CS-1 project does not envision modification to the existing dust suppression preparation plant. NSC CS-1 design will foresee the arrangement of the site for solution preparation and pipeline from the site to the new mobile DSS.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.18 Fire-protection system

The main purposes of the NSC fire protection systems are:

- Create conditions so that any fire situation will not become an initial event for radiation accident;
- Provide for conditions of early and quick suppression of a fire;
- Reduce to the maximum extent the consequences of fire impact on people and material.

The basic functions of the NSC fire protection systems are the following (GOST 12.1.004-91):

- Fire detection at the early stage of its development;
- Restriction of fire spread along the rooms of the facility;
- Restriction of dangerous fire factors impact on people, including radiation impact.

The NSC fire protection systems consist of passive and active fire protection systems. The passive fire protection systems include:

- Fire protective barriers;
- Fire compartments and sections;
- Personnel evacuation pathways.

The active fire protection systems include:

- Automated fire alarm plants;
- Automated fire extinguishing units;

- Fire alarm announcing system and evacuation management, announcing system to fire brigade;
- Smoke protection and ventilation system;
- Firewater supply system;
- Primary fire extinguishing equipment.

All elements of fire protection system shall fulfil respective functions meeting the DCR stated in Chapter 2 of this document.

1.4.2.18.1 Purpose of fire protection barriers

The purpose of fire protective barrier arrangement is to avoid fire from developing and distributing between rooms separated by such a barrier during a defined time limit. They will keep:

- Their bearing capacity (for bearing building structures);
- Their integrity (or partition capability);
- Their insulation capability.

Fire protective barriers include fire protection walls, partitions and slabs. Fire protective doors, gates, windows, hatches, valves, curtains (screens) are applied to fill the openings in fire protective barriers. The degree of resistance required for the facility is defined in chapter 2.

1.4.2.18.2 Purpose of the compartment and section

The purpose of the facility subdivision into fire compartments and sections is to restrict the development of fire inside. The purposes of the subdivision of the facility are:

- To prevent fire distribution from a room (group of rooms), allocated to a fire compartment (section), to adjacent rooms, as well as from adjacent rooms to the subject fire compartment (section);
- To maintain structural bearing and partition capability of a fire compartment (section).

1.4.2.18.3 Purpose of the emergency exits

Evacuation pathways and exits shall be created in order to evacuate personnel safely in case of a fire. Evacuation pathways and exits perform the following functions:

- Conditions for timely and free evacuation of the people in case of fire;
- People protection on evacuation pathways from dangerous fire factors impact.

Personnel evacuation in case of fire shall be enabled along the evacuation pathways through evacuation exits.

The emergency exit pathways will also be laid out to ensure the evacuation of personnel from the NSC in the case of a radiation accident. As far as it is achievable, the emergency exit from the NSC will take place through the main sanitary lock in order to avoid contaminated personnel to exit directly the facility to the outside.

1.4.2.18.4 Purposes and functions of the automatic fire alarm

The purpose of the automated fire alarm unit is to ensure automated fire detection. Automated Fire Alarm System (AFAS) units are designed for fire detection, provision and processing of fire

notification at the facility. In the event of fire, the AFAS will then, through the processing of special information and instructions, switch on fire units and other technical devices.

Automated fire alarm units shall perform the following functions:

- Actuate (fire detection) at the initial stage of fire development;
- Process and present notification of fire alarm;
- Produce control instructions for actuating elements;
- Provide required functioning reliability.

AFAS shall operate continuously and around the clock in automated operation mode during the whole lifetime. The main operation mode of AFAS is in an automated stand-by mode.

In stand-by mode AFAS shall perform the following informational, control and monitoring functions:

- Monitoring (initial measurement, acceleration and conversion) of the signals of fire announcers that analyze environment state in the protected rooms and explosive and fire risk zones of the facilities;
- Diagnostics (self-diagnosis) of the fire-receive monitoring device status, fire announcers and signal lines;
- Personnel notification on origins of violations of normal operation;
- Information collection and initial processing;
- Information provision, recording and archiving;

In “Alarm” mode the AFAS shall perform the following informational and monitoring function:

- Personnel notification of violation of safe operation conditions (“Fire” emergency alarm);
- Forming of protective action instructions, provided for the detected initial event (fire);
- Representation of output command impulses at the execution units of adjoining fire protection devices and engineering equipment in the facility;
- Prohibition or disconnection of the impacts on actuating elements that can be initiated by the operational personnel if their actions do not coincide with control system instructions.

Performance of the AFAS system main functions stated in this section will make it possible to detect fire at an early stage of its development and, thus, to allow required measures to be taken in time to prevent the damage of structures and main equipment.

1.4.2.18.5 Purpose and function of the fire extinguisher system

The purpose of the automated fire extinguishing is to extinguish fire automatically by spraying and dispersing quantities of appropriate fire extinguishing substances. The automated fire extinguishing units shall perform the following functions:

- Actuate (detect fire and discharge fire extinguishing substance) at the initial stage of fire development;
- Circumscribe fire for the period required for actuation of operative forces and equipment, or its liquidation;
- Provide the required supply and (or) concentration of fire extinguishing substance;
- Perform the necessary functions with the required reliability.

1.4.2.18.6 Purposes and functions of the fire warning and evacuation management

The purpose of fire alarm announcement and the evacuation management system is to assure safe evacuation of the personnel in case of fire.

The functions of the system are the following:

- Notification of the personnel in the event of fire in the facility;
- Management of personnel evacuation.

Personnel shall be warned of the fire in one of the following ways:

- The production of audible and (or) visual signals to all the rooms of the building of permanent and visiting personnel;
- Broadcast of evacuation necessity verbal messages, evacuation pathways and other actions aimed at personnel safety assurance.

Evacuation management shall be performed with the following:

- Switch-on evacuation lighting and evacuation direction lights;
- Broadcast of specially developed texts on the fire alarm (announcement) system, aimed at prevention of panics and other events complicating evacuation process (accumulation of people in passageways etc.);
- Broadcast of texts containing information of the necessary traffic route.

1.4.2.18.7 Purpose and functions of the smoke exhaust system

The purpose of the smoke protection system creation is to maintain safe evacuation of people at the initial stage of fire, whilst preventing the impact on personnel of smoke and increased temperature, resulting from the burning of toxic products.

The functions of the smoke protection system are the following:

- Remove smoke from the rooms, evacuation corridors and halls (not in the entire volume under the arch);
- Create overpressure of clean air along the evacuation pathways (in lobbies-locks etc.);
- Reduce smoke generation and air temperature along evacuation pathways because of smoke suppression;
- Provide air supply to fireproof locks, staircases and other protected spaces (in accordance with the normative requirements) in order to create overpressure (positive pressure) and prevent effects of the hazardous risks of fire on people.

1.4.2.18.8 Purpose and functions of primary fire extinguishing equipment

The functions of the primary fire extinguishing equipment are the following:

- Provision to the personnel of the supply of fire extinguishing means (fire-extinguishers, boxes with sand, tanks with water, etc.);
- Provision to the personnel of the fire extinguishing means feeding (fire buckets, shovels, etc.);
- Provision to the personnel of the fire extinguishing means (fire-extinguishers, coverlets made of incombustible heat-insulating materials, fire mats, etc.);
- Provision to the personnel of the fire tools for deconstruction of structures (hooks, craw-bars, axes, etc.)

1.4.2.19 NSC integrated control system

The NSC integrated control system (ICS) aims to control the operation of the main process equipment and to monitor the operation parameters and the main characteristics of the NSC. The ICS, together with other systems and subsystems will ensure nuclear, radiation and industrial safety of the NSC when supporting the equipment operations; requiring minimal intervention of operations, maintenance and repair staff.

The ICS will encompass at least the following:

- Monitoring systems:
  - Radiation monitoring (RMS);
  - Seismic monitoring (SMS);
  - Structural and foundations monitoring (SFMS);
- Operation support systems:
  - Heating, ventilation and air conditioning system;
  - Water supply and sewage system;
  - Power supply system;
  - Dust suppression system.
- Systems for monitoring and control of technological processes (if needed) and the display at the Central Control Panel (CCP) of information related to basic parameters and failures of the equipment elements of these systems, and their possibility of start-up/shutdown.
- Crane equipment monitoring and control system

NSC ICS will be designed taking into account the Integrated Automated Monitoring System (IAMS) of the OS and Integrated Database (ISDB) of the OS, being developed within the frame of SIP Tasks 17 and 18. The respective server might be proposed for mutual information exchange between the ICS NSC and IAMS OS.

In order to ensure safety of the NSC, the ICS will interface with the following independent systems:

- Fire safety system;
- Physical protection system (PPS).

ICS NSC shall ensure permanent monitoring and control of different NSC systems throughout its life time. It shall be achieved by development of an open (i.e. not using proprietary systems, interfaces and protocols) extendible, modular, reliable and safe system.

Control systems shall function independently and facilitate the collection, procession, accumulation, display, analysis and archiving of the obtained information, issuance of the reports, and perform other required functions.

The systems forming the ICS should ensure the following:

- Alarm when achieving and exceeding established operation limits for monitored parameters;
- Transfer of the processed data to the upper level system;
- Data archiving in case of upper level system failure.

Local control panels will be envisaged for operation support and technological process systems. Control of other systems spread all around the facility, as well as monitoring of the systems controlled from the local panels, will be performed at the Central Control Panel (CCP). Control

means monitoring, automated and remote control, technological protection and blocking, alarm and information archiving.

The Work place of the chief facility operator is located at the CCP. Process systems operators should be located at the local control panels.

All ICS systems and subsystems shall perform their respective functions meting DCR stated in Chapter 2 of this document.

1.4.2.19.1 Functions of the radiation monitoring system

The radiological monitoring system provides monitoring of radiation exposure parameters and properties as well as their sources, in order to determine exposure doses for personnel and radiation conditions of the industrial and natural environments.

The RMS will include

- Process radiological monitoring;
- Dosimetry radiological monitoring;
- Radiological monitoring of the non-dissemination of radioactive contamination;
- Radiological monitoring of the environment (releases and discharges).

According to OSPU and other Normative Technical Documentation (NTD) of Ukraine, the NSC CS-1 RM system shall monitor the following[*]:

- Personnel and PPE;
- Work places of the personnel;
- Rooms where the works are performed and those adjoining them;
- Access routes;
- Sanitary locks and change facilities;
- Technological processes, in particular the working medium used in them (see note below);
- Fixed and portable (mobile) equipment (RMS design will include possible installation of portable and fixed equipment (for radiation monitoring of the performance of technical operations of the unstable OS structures deconstruction and management of these structures). RMS will have a connection possibility for this equipment and will ensure function performance, taking this equipment into account;
- Transportation means (see note below);
- Radioactive waste;
- Airborne particulate and gas releases;
- Liquid discharges;
- NSC site (see note below).

The following parameters are subject to monitoring in this case:

[*] Note. To the extent necessary for the CS-1 operation, as well as equipment, systems and facilities maintenance needs (excluding the needs for direct NSC CS-2 deconstruction technological processes), fixed and portable (mobile) equipment (for radiation monitoring of the performance of technical operations of the unstable OS structures deconstruction and management of these structures) are out of NOVARKA's scope.

- Exposure dose rate: in the rooms (in the areas, access ways, in sanitary locks, change facilities, etc) of NSC various zones;
- EDR from the technological equipment, working medium, near protective barriers and on the site;
- Activity concentration (alpha-beta activity) of airborne particulates in rooms (in the areas, access ways, in sanitary locks, change facilities, etc) of the various NSC zones and on site;
- Activity and radionuclide content of gas release through ventilation and leakage;
- Activity and radionuclide content of discharges from NSC as well as ground waters at the NSC industrial site based on the existing system;
- Activity, surface contamination and radionuclide content of generated RAW (solid and liquid);
- Radioactive materials contamination level (density of alpha and beta-particles flux) of the surface of the industrial rooms (in the areas, access ways, in sanitary locks, change facilities, etc), equipment, territory and facilities on the site;
- Radioactive materials contamination level of the surface of vehicles during their crossing the borders of different zones and NSC territory;
- Individual dose exposure (internal and external) of the personnel;
- Contamination level of skin, shoes, industrial and personal clothes, PPE.

[**]The RMS will take into account the needs of the NSC CS-2 project, in particular:

- RMS reserve capacity for equipment, required for NSC CS-2;
- Places for additional measuring channels tie-in/connection for NSC CS-2.

1.4.2.19.2 Functions of the seismic monitoring system

The seismic monitoring system shall monitor the behaviour of the arch foundation and basement under seismic loading. It will also monitor the free field (ground beyond the influence of surface and subsurface structures) and the NSC under the seismic loads

The NSC SMS will interface with the IAMS for data exchange.

The system will include at least one sensor of seismic acceleration, amplitude, frequency and direction located in the ground around the NSC (free field), and sensors located at selected points of the foundation and Arch structure. The quantity of these sensors will be sufficient for characterization of the foundation and Arch structure reaction as a result of seismic events.

The SMS provides for collection and processing of data on seismic impact; acceleration, amplitude, frequency and direction of vibration of soils, foundations and the NSC structures at the areas of check points and processed data transfer.

1.4.2.19.3 Functions of the structural and foundation monitoring system (SFMS)

The SFMS is designed for monitoring of the structures' condition where it may impact the bearing capacity of separate areas, or integrity of the enclosure as a whole.

[**] Note. Leakage releases may be estimated by measuring the specific activity of the air in leakage points and estimating the maximum air leakage rate.

SFMS shall monitor horizontal, vertical and rotational foundation displacements. SFMS shall include bench marks built in the pilecaps and along the western wall and located outside the structure. The location of built-in bench marks will make possible to determine displacement and rotation of the foundations. Geodesic survey from the constant base of these bench marks shall make it possible to measure displacements and their rate.

Because of its large size and flexibility, the Arch will be subject to linear and angular displacement due to daily air temperature changes, solar radiation, wind, snow load etc. Therefore, monitoring its behaviour would lead to misleading information and it is thus more relevant that the SFMS focuses on the foundations.

1.4.2.19.4 Functions of the ICS in the monitoring and control of the HVAC

The ICS will monitor the operational parameters of the ventilation system i.e.

- Air temperature, flow rate and head pressure inside the annular space;
- Air temperature inside the main volume;
- Air temperature and pressure in the main process areas such as the decontamination workshops, the crane park and the trolley maintenance garage, the initial treatment area;
- Air temperature in the main rooms occupied by personnel;
- Any parameter participating in the safety of the operation of ventilation, gas purification and conditioning of the main NSC facility, the technological building and the auxiliary buildings.

The complete list of monitored parameters and controlled actuators will be defined during the Design based on the safety assessment and in the development of the operation manuals.

1.4.2.19.5 Functions of the ICS in the monitoring of the water supply and sewage system

The ICS will report all operational parameters of the water supply and sewage system. It will consist of monitoring:

- The water flow rate at the inlet of the NSC and technology systems, sites, etc.;
- The level of liquids in the various tanks of the facility;
- The status of valves, pumps and other actuators on the water process lines;
- The presence of liquids in the drip trays located under the rooms of the tanks in order to detect spillages or floods taking place at the main NSC facility, in Technological building and auxiliary buildings;
- Other operation parameters defined during the design.

The firewater supply system, on account of its importance to safety, will be connected to a dedicated safety programmable logic controller. The ICS will only be able to monitor the operational and safety parameters of this system and engage the necessary alarm in case of failure.

The complete list of monitored parameters and controlled actuators will be defined during the Design based on the safety assessment and in the development of the operation manuals.

1.4.2.19.6 Functions of the ICS in the monitoring and control of the power supply system

Similar to the above system, the ICS will display the main characteristics of the power supply system (status of the transformers, voltages and intensity, power consumption).

It will be possible from the central control panel to switch from one power supply source to the other one.

The complete list of monitored parameters and controlled actuators will be defined during the Design based on the safety assessment and in the development of the operation manuals.

1.4.2.19.7 Functions of the ICS in the monitoring and control of the dust suppression system

At this stage of the Design, the ICS will not communicate with the dust suppression system.

1.4.2.19.8 Functions of the ICS in the monitoring and control of the processes

The information will come to the ICS from only those systems and components ranked as important to safety or those systems and components located in the first ans second zones.

All the others will be monitored and controlled locally by operation personnel. This concerns mainly the main cranes.

1.4.2.20 Solid radioactive waste management system

The solid radioactive waste management system has the following functions:

- Collection of solid radioactive waste generated during operation. This includes primary waste (rubbles and debris removed from the Shelter…) and secondary waste (consumable parts, spent tools or systems, protection vinyl, gloves…);
- Segregation of waste according to their physical characteristics (size, suitable for compaction), chemical (presence of organics, metal…) and radioactivity (beta activity, level of alpha activity, quantity of fissile materials…);
- Size-reduction of waste items to a size suitable for transportation or loading into a container;
- Packaging of radioactive waste according to the requirements for their future storage and repository;
- Assay to determine the actual quantity to be packaged and shipped;
- Non contamination checking on the containers;
- Production of the certificates (passports) before shipment to ChNPP solid waste management system,
- Buffer storage of radioactive waste in order to organise shipments.

This system shall fulfil these functions meeting DCR stated in Chapter 2 of this document.

1.4.2.21 Crane and transportation equipment inside NSC

This system includes the main cranes located at the top of the NSC volume, the 20 t semi-gantry crane and the 15 t carriages servicing the initial treatment areas, the preparation area and the lateral airlocks and various forklifts transferring radioactive materials from the technological building to the waste buffer store and to the truck airlocks.

This system also includes the associated maintenance garage and rooms for the management of crane trolleys.

All these systems participate to the functions relating to the dismantling of unstable structures and thus to the conversion of the Shelter Object into an environmentally safe system.

The functions of the main cranes are:

- Hooking and transfer of the unstable structures to the initial treatment area;

- Transferring temporary support structures for the in situ preparation of the Mammoth beam before removal and transfer;
- Loading and transfer of a shielded box to convey personnel to the workplaces inside the Object Shelter;
- Grabbing and transfer of radioactive waste and fuel containing materials for transfer to the dedicated treatment area;
- Transferring specific tools for operations inside the Shelter at the bottom of a telescopic mast;
- Transferring the mobile dust suppression system over the Object Shelter for spraying the mixtures;
- Transferring a vacuum cleaner at the bottom of the telescopic mast in order to reduce the amount of dust fixed on the unstable structures before their handling;
- Other activities to be determined in the framework of the NSC CS-2 design.

The semi-gantry crane aims to service the site of preliminary processing, preparation, temporary storage and loading of vehicles and the truck loading area. It will handle the dismantled structures, radioactive waste and other items of waste prepared for shipment onto trucks. It will also be used to transport from the truck loading area to the NSC empty waste packages and possible over-packs.

The 15-ton carriage will transport packages containing radioactive waste and FCM from the lay-down area to the northern truck airlock. It will aim to transfer waste packages produced in the lay-down area.

This system also encompasses a crane park and a trolley maintenance garage providing protection for operators to:

- Dismount components on the main cranes;
- Repair main crane components and replace spare parts and consumables on the main cranes;
- Change tools and store tools for the telescopic mast;
- Decontaminate the main cranes if needed.

This park and this garage also provide for containment in order to avoid contamination being released throughout the NSC main facility when performing activities which might re-suspend dust.

This system shall fulfil the functions meeting DCR stated in Chaper 2 of this document.

1.4.2.22 Areas and equipment for remote deconstruction of unstable structures

The area for remote deconstruction of unstable structures provides for the conditions to ensure deconstruction activities in the frame of the strategy for the conversion of the OS into an ecologically safe system. It provides rooms for processing unstable structures, FCM and radioactive waste.

The lay-down area is the main item of this system. In the frame of the CS-1 project, the lay-down area will be designed with specific interfaces with the CS-2 activities. Nevertheless, its dimensions and equipment will be checked to ensure that the conditions are also suitable for future RAW and FCM removal from the OS.

The area will receive the dismantled elements coming from the OS and directed to the treatment process. This L-shaped area is located in the western part of NSC under the main cranes, and is separated from OS by the use of walls but without roof.

The minimum dimensions of the lay-down area are defined by the longest and largest elements to be processed:

- Largest element in East-West direction of the lay-down area = Dog house;
- Longest element in South-North direction of the lay-down area = B1 beam;
- Highest element = width of Southern hockey stick panel.

Considering the main cranes, the lay-down area does not need to be fitted with any complementary permanent handling equipment, but it offers a large area for access to the OS using equipment, such as mobile cranes, for future operations.

To allow their transfer in the initial treatment area, the largest dismantled metallic structures will be size-reduced in the lay-down area.

The lay-down area will be fitted with all utilities (industrial water supply, ventilation, power supply, fire-water supply) and monitoring systems (fire detection, radiation monitoring) to allow for safe performance of the CS-2 operations.

This system shall fulfil the functions meeting DCR stated in Chapter 2 of this document.

1.4.2.23 Areas and equipment for preliminary processing

The preliminary processing area provides for the conditions to ensure deconstruction activities in the frame of the strategy for the conversion of the OS into an ecologically safe system. It provides rooms for processing unstable structures, FCM and radioactive waste.

This area shall be used for the basic treatment of dismantled elements or debris containers to reduce the spread of radioactive contamination and personnel exposure before further treatment.

The area shall be designed for the implementation of:

- A 20-ton semi-gantry crane;
- Fragmentation and dust suppression devices ;
- A mobile hopper system.

The area shall be completely confined with permanent biological walls (to ensure further radiological classification of zone 2) and a roof with openings.

The arrangement of the area shall include:

- Provisions for a 15-ton carriages railway;
- Provisions for a semi-gantry crane railway covering the whole area (20-ton and 18 m span), in the continuity of the truck loading area semi-gantry crane;
- Pipes for the special sewage system (LRAW management system);
- Provisions for the ventilation system;
- Local reinforcement of the slab in the Hopper Zone and under the maintenance garage for NSC main crane carriages;
- Other required engineering networks (power supply, water supply), control systems, fire protection system.

This area shall fulfil functions meeting the DCR stated in Chapter 2 of this document.

1.4.2.24 Preparation area

The preparation area provides for the conditions to ensure deconstruction activities in the frame of the strategy for the conversion of the OS into an ecologically safe system. It provides rooms for processing unstable structures, FCM and radioactive waste.

The preparation of wastes, for their transportation outside the Arch to the RAW management facility, will be performed in this dedicated area. The deconstruction studies and RAW management facility design will define the necessity for construction of additional means for the preparation of waste inside the Arch.

This zone may be equipped by others with various workshops allowing the preparation of waste for their exit via the truck loading area. For example, the following functions may be installed:

- A decontamination or contamination fixation area;
- A cleaning (washing / dusting / vacuum cleaning) area.

The arrangement of the area shall include:

- Provisions for a 15-ton carriage railway;
- Provisions for a railway for a semi-gantry crane covering the whole area (20-ton and 20m span), in the continuity of the truck loading area semi-gantry crane;
- Pipes for the special sewer drainage system;
- Provisions for the ventilation system;
- Foundations and biological walls surrounding the zone to ensure radiological classification of zone 2;
- Roof;
- Other required engineering networks (power supply, water supply), control systems, fire protection system.

This area shall fulfil functions meeting the DCR stated in Chapter 2 of this document.

1.4.2.25 Temporary storage area and southern airlock for large trucks

This system creates necessary conditions for practical activities on OS conversion into an ecologically safe system, including dismantling/stabilization of unstable OS structures, works performance on RAW management. It also provides for necessary technological space for further arrangement and application of FCM and concomitant RAW extraction technologies.

The temporary storage area is designed for temporary storage, preparation of contaminated dismantled OS structures and concomitant RAW, their loading and transportation for sending to SSE ChNPP infrastructure on RAW management

Southern sliding gates with air lock are designed for transportation of materials and equipment by large-dimension transport.

The temporary storage area and southern airlock will be equipped with all the necessary NSC life-supporting and control systems; and these shall fulfil respective functions meeting DCR stated in Chapter 2 of this document.

1.4.2.26 Truck loading area, guard houses (KPP) and Northern gates for standard vehicles

This system creates necessary conditions for practical activities on OS conversion in an ecologically safe system, including dismantling/stabilization of unstable OS structures, works

performance on RAW management. It also provides for necessary technological space for further arrangement and application of FCM and concomitant RAW extraction technologies.

Trucks loading area, crane (20 tons) with control system, northern gates for passage of standard transport, radwaste, other exported cargoes and trucks exit monitoring point are designed for arrangement of RAW transportation, other cargoes transportation from NSC.

Non-distribution of contamination outside the limits of arch during gates opening is provided with the help of the northern gates' ventilation systems.

Trucks loading area, KPP and northern gates will be equipped with all the necessary NSC life-supporting and control systems; and these shall fulfil respective functions meeting DCR stated in Chapter 2 of this document.

1.4.2.27 Packaged RAW temporary storage area

The packaged RAW temporary storage area and southern airlock for large trucks provide for the conditions to ensure deconstruction activities in the frame of the strategy for the conversion of the OS into an ecologically safe system. It provides rooms for processing unstable structures, FCM and radioactive waste.

The packaged RAW temporary storage of RAW is intended to store waste before shipment to an interim storage facility or a final repository.

This area needs physical separation from the OS and other areas within the NSC that could experience radiological events, in order to prevent contamination of the clean packaged wastes. This separation will be achieved by erecting light walls and a light roof over the area.

The packaged RAW temporary storage area will ensure the integrity of the packages by addressing:

- Fire. The area will include provisions from the fire detection, alarm and fighting system;
- Load drops. For this, the area will be located remote from the span of the main cranes;
- Contamination arising from any initial event. The area will be fitted with light walls and roof ensuring containment.

In addition, the packaged RAW temporary storage slab will be covered with a waterproof coating allowing easy decontamination. The slab surface will drain to the NSC LRAW management system.

This area shall fulfil functions meeting DCR stated in Chapter 2 of this document.

1.4.2.28 System of physical protection and access control (SPPAC)

System of physical protection and access control of the NSC shall facilitate the fulfilment of the following functions:

- Control and management of access to the zones of restricted access and to life-important locations of NSC;
- Revelation of attempts and banning the non-authorized penetration into NSC, non-authorized displacement of FCM and other sources of ionising radiations beyond its limits;
- Obtaining of information related to people presence in NSC.

NOVARKA will reserve the room (per rough assessment with square of 70m2) at the entrance to the NSC Technological building for the future installation (by other Contractors) of the equipment for the SPPAC (turnstiles, card readers, etc.). NOVARKA will determine the factual needed square in the design.

NOVARKA will equip the doors with the sensors and locks at the access ways to the sites, areas and equipment with restricted access. The signals from the sensors shall come to the Access Control and Physical Protection System developed and installed by the other organizations.

1.4.2.29 Technical means to ensure NSC personnel safety

This system provides for portable equipment, personnel protection equipment and goods to ensure personnel safety during the operation of the NSC from the point of view of radiation protection, fire protection, industrial safety and emergency planning.

It consists of storage and warehouses to hold stores and make accessible all these items to operational personnel before entering the technological building and, further on, the main NSC facility.

1.5 NSC CS-1 EMPLOYER AND CONTRACTOR

1.5.1 EMPLOYER

The Employer is ChNPP. The main areas of Employer's responsibilities are:

- To provide utilities and services for the performance of the Works, i.e.
  - On-site areas and site features such as the Erection and Assembly Areas and the Areas for site facilities;
  - Site preparation works i.e.; the removal of the Berm of the pioneer wall,
  - Excavation works down to absolute level 113.5 of the foundation area at the areas handed over with preliminary preparation in accordance with the item 2.4.1 of the Scope of Work;
- To provide services during Design:
  - ChNPP is to obtain from the Regulatory and oversight agencies the Agreement on Design and Authorisations to proceed with new construction from the State Architectural and Construction Surveillance Agency for commissioning and operating stages from SNRC and Ministry of Health according to the Licensing Plan;
  - ChNPP will review the documents submitted by the Contractor following a detailed review process;
  - ChNPP will provide, upon Contractor's request, available information on site data and interfaces with other projects;

  The responsibility share between the Employer and the Contractor during the design effort is also described in Section 1.5.3.
- To define a technical review team working in the Contractor's office to review the documents produced by the Contractor and to review intermediately the principal engineering solutions. The Employer (The Engineer) shall have the right to audit Contractor's quality system, including sub-contractors and lower-tier subcontractors, at any stage of work implementation, including the right to involve any third organization for these purposes. Contractor shall perform corrective measures based on the results of the audits. The Employer will perform oversight control in accordance with the Quality Surveillance Plan including scheduled and un-scheduled surveillance during Construction and Manufacture. The Employer will also be responsible for the performance of final control on material inspection and testing performed by the Contractor. "
- To provide 1000 places in the change facility in order to allow access to the Work areas;
- To designate organisations for the medical examination of the Contractor's personnel and to provide scheduled, off-scheduled, emergency medical exams of the biophysical conditions of the Contractor's personnel in order to determine internal exposure dose rate;
- Emergency aid at the ChNPP Industrial site and transportation of the victims to the medical establishments;
- The passportisation including characterisation of radioactive waste materials. ChNPP will assure management of the waste item of category III discovered during construction.
- To provide dosimetry control equipment (Bioassay, TLD, whole-body counts) to the Contractor. ChNPP will also provide radiological monitors and accounts of dose uptake. ChNPP will provide daily measurement of radiation situation in the working area before

issuing unified access permits. Both Employer's and Contractor's radiological monitoring will be implemented and coordinated between each other in order to fully met DCR stated in Chapter 2 of this document;

- To provide for the certification process for all Goods imported by the Contractor to Ukraine, which have not already been certified in Ukraine;
- To provide an on-site custom clearance facility. ChNPP is responsible for the custom clearance;
- To provide theoretical training on site to develop skills of safe working methods under radiological hazardous conditions.
- To provide upon Contractor's request Technical Specification to connect NSC CS-1 to utilities and communication networks of SSE ChNPP/SO

Before commissioning, Commissioning Test plan will be produced by the Contractor and submitted to the Employer for review. It will include the pre-commissioning acceptance criteria. Moreover, The Contractor will provide Commissioning Test Procedure, which defines the testing and commissioning procedures and methods. These procedures and methods shall be developed in full compliance with the Manufacturer or Vendor's data and the Applicable Norms and Standards

The Employer's responsibilities during commissioning and trial operation will be defined in the Commissioning Testing program.

The Employer will provide operating personnel to operate Confinement systems equipment in the course of this testing.

The Employer's personnel under supervision and responsibility of the Contractor will carry out Commissioning Testing Plan in order to check the correctness of operation, to determine actual quantitative and qualitative characteristics, to verify personnel readiness for work under operation conditions, to amend operation documentation (if required)."

1.5.2 CONTRACTOR

The Contractor is NOVARKA. It is a Joint-Venture between two major French construction companies: VINCI Construction Grands Projets and BOUYGUES Travaux Publics.

NOVARKA is responsible for performing the following tasks:

- **Task 1 Services Works**
  - **Task 1.1 Project Management**. This task involves planning, organisation and Work/Service control that are performed by NOVARKA.
  - **Task 1.2 Engineering Services**. This task involves site investigation and testing, detailed design, development of construction organisation plan, licensing support services. Moreover, NOVARKA will develop and implement a technical and scientific support program in compliance with the Applicable Norms and Standards.
  - **Task 1.3 Procurement Services**. This task involves development of a procurement plan, definition of procurement solutions, supply of equipment and goods which will be used during the construction activities. NOVARKA will ensure development of all documentation prior to procurement and will provide documents for custom clearance. The Contractor will develop Technical Specifications for procurement. The Technical Specification for equipment and systems related to radiation, nuclear, fire and industrial safety, in strict accordance with the Licensing Plan, shall be reviewed and concurred by regulatory and supervising agencies as a part of or based on the approved design/working design

- **Task 1.4 Construction Services**. NOVARKA will provide construction services in conformity with the Detailed Design, technical specification, quality and organizational documentation developed during the Project. The construction activities will be organised by NOVARKA with NOVARKA's personnel and subcontractors. NOVARKA will also operate the site facilities which are required for safe and effective construction including the batching plant, materials store and vehicle maintenance workshops. Before Works implementation, NOVARKA will produce the Construction Organisation Plan and Work Execution Packages which will include the Work Execution Plans, Industrial Safety and Health Measures and Procedures, a waste management plan, a radiation safety program, and a quality surveillance plan.
- **Task 1.5 Training Services**. NOVARKA will provide training of the ChNPP's operation personnel in order to operate equipment during the pre-commissioning and commissioning tests.
- **Task 1.6 Test on Completion services**. NOVARKA will perform the tests on Completion which encompasses pre-commissioning before sliding the Arch to its final position and Commissioning once the Arch is in its final position and all tests are connected to the Auxiliary Building.
- **Task 1.7 Taking Over Services**. NOVARKA will ensure closeout & final acceptance plan that defines operation manuals and maintenance manuals, inclusive of technological regulation on NSC operation (including SO), cost estimates, as-built drawings, certificates and owner inspections required for final acceptance and turnover.
- **Task 1.8 Work Execution Surveillance and Quality Control Services**. NOVARKA will ensure surveillance of manufacturing and construction in order to guarantee that every good procured, manufactured and built is compliant with the Design. NOVARKA will develop methods of testing in accordance with applicable norms and standards.
- **Task 1.9 Other Services**. NOVARKA will ensure decontamination of tools, equipment and transportation means in accordance with applicable rules (for VS-2 removal task, specific requirements will be specified by the Employer). NOVARKA will also ensure services to facilitate the nuclear, radiation and ecological safety and implement the ALARA principle during work and commissioning, and management of radioactive soils and materials during excavation works (except for those within the Employer's responsibility). Furthermore, NOVARKA will implement fire, industrial and health safety services. Finally, during construction and commissioning, NOVARKA will ensure site cleaning and waste removal from the work area. The requirements and the share of responsibility on solid and liquid radioactive waste management during construction and commissioning are provided in section 2.8 of the CDSD. This section is based on the document "Management of Soils and other Materials". The requirements for ensure radiation safety: zoning, sanitary and hygiene, dust suppression, decontamination of working areas, waste management at crossing boundaries of zones, etc. are reflected in corresponding sections of CDSD Chapter 2. The requirements to fire safety are provided in Section 2.9.3 of the CDSD.

- **Task 2 Site Facilities**. This task includes:
  - Construction of on-site facilities such as on-site access routes, electrical power, water and sewage systems for construction works;
  - Construction of off-site facilities needed to pre-assemble, store, maintain and protect goods and materials and to produce concrete.
- **Task 3 Arch Foundations and Sliding System**. This task consists in constructing the foundations of the Arch in the local zone and the foundations along the sliding and assembly areas. It also encompasses the design, manufacture and operation of the sliding system.

- **Task 4 Arch and Main Cranes System**. NOVARKA will provide an arched roof in the East-West direction closed by Western and Eastern walls. It also includes cladding and ceiling systems and the main-cranes which will be further used for the dismantling of the Shelter. NOVARKA will not design and provide the tools handled by the main cranes systems. NOVARKA will not perform the design, construction and commissioning of the New Ventilation Stack.
- **Task 5 Confinement Auxiliary Systems and Facilities**. NOVARKA will equip the NSC with the systems listed in section 1.4. This task excludes provision of the Nuclear Safety Monitoring System, the FCM monitoring system, Physical Protection and Access Control System (except the provision described in section 1.1.3.3.1 of document [29]), Local Dust Suppression System for Deconstruction Activities;
- **Task 6 Ventilation Stack Removal**. NOVARKA will design and perform the removal of the old VS-2 ventilation stack and its supporting structure and manage its fragments as radioactive waste.

These tasks will be carried out in accordance with the scope, requirements and criteria listed in CDSD Chapter 2 on the basis of the initial data provided in chapter 3 with the design logic presented in Chapter 4.

1.5.3 SHARE OF RESPONSIBILITY DURING THE DESIGN AND FURTHER

1.5.3.1 Development of licensing documentation

As a part of the Detailed Design, the Contractor will develop and submit to the Employer the Design developed according to the Decree #421 and according to the Licensing Plan and the “Design Criteria and Requirements” Document.

In addition the Design will include the following documents:

- The Safety Analysis Report (SAR),
- Sanitary Compliance Report (SCR).
- Environmental Impact Assessment report (EIA)

The Structure and content of the EIA, SAR and SCR will be in compliance with the Applicable Norms and Standards, the Licensing Plans and the Clarifications on Structures and Contents referenced in the Licensing Plan.

These documents will provide a comprehensive safety analysis; furthermore, the NSC and OS structures, systems and equipment shall be addressed as a single facility. The share of responsibility between the Contractor and Employer on the drafting of relating information from OS structures (including their future reinforcement) and systems will be arranged when defining the structures and contents of these documents.

It is to be noted that the SAR will describe Emergency planning including share of responsibilities” and that “specific emergency planning shall be described in COP and WEP.

SSE ChNPP is responsible for obtaining in AEZ of permit for construction, obtaining from SACS a permit for implementation of construction activities. SSE ChNPP shall obtain from the regulatory and oversight authorities the concurrence of the design and design and technological documents for performance of the preparatory works, documents containing the additional criteria, requirements and input data (additional for CDSD), etc. listed in Section 4.6 of CDSD.

Contractor/Subcontractors are responsible for obtaining permits and licenses for implementation of certain types of works (for example, licenses of Minregionstroy, permit of State Municipal

Industrial Surveillance, License for RAW handling (during work performance on assembly zone clearance)).

1.5.3.2 Transfer of available information

The Employer will provide, upon Contractor request, the Contractor with available information on site data and interfaces with other projects (For non-available information, the Contractor shall perform the necessary investigations). List of the additional input information to be required in the process of design is presented in Section 3.9.

In particular, the Employer will provide to the Contractor upon Contractor request, available and necessary information to manage interfaces with existing systems and with systems designed by other contractors.

1.5.3.3 Use of foreign norms

In case of application of foreign standards, the Contractor shall perform the analysis of compliance of the foreign normative documents with the requirements of the normative documents of Ukraine in the scope and format concurred with ChNPP and appropriate regulatory authority. SSE ChNPP shall concur the application of the foreign standards with the appropriate regulatory authority.

1.5.3.4 Site arrangement

The Employer provides the Contractor with the following areas without preliminary preparation and with the structures, buildings and networks located on them:

- Contractor Erection and Assembly Areas,
- Arch Western and Eastern end wall foundation area and area for the Confinement Auxiliary facilities.

The site preparation performed by the Employer is limited to the following:

- Withdrawal of the Berm of the pioneer wall located between axis 38 and 56 of ChNPP main building and approximately 30-metre South from row “A”.
- Excavation down to absolute level 113,5 of the foundation area (limited to the dimensions of the Conceptual Design foundations)”.

All other site preparations, relocation of buildings, excavations beyond the area excavated by the Employer, are Contractor’s responsibilities.

The Contractor will determine the list of off-site facilities during the first stage of Detailed Design. The Contractor is responsible to define, rent equip and operate as well as obtain the necessary authorizations from the local authorities in order to manage the facilities he needs such as river, railroad and road networks, ports, railway stations, airports, unloading platforms, material buffer storage, or any other infrastructure or superstructure identified in the procurement plan for delivery of personnel, materials and equipment to the Site.

Small Stroybaza (SSB) facilities are provided at no additional cost at the Contractor's disposal until the end of the Contract. The Contractor is responsible for the operation and maintenance of these facilities”.

1.6 INTERACTION WITH THE REGULATORY AND SUPERVISING AUTHORITIES

An important condition for implementation of NSC project is the preparation of packages of licensing documents and their submittal to Regulatory and Supervising Authorities for further Authorisation to proceed with Construction, Commissioning and Operation. In compliance with the Ukrainian legislation in regulating activities in the sphere of nuclear power usage and radiation safety and [13, 14], SSE ChNPP developed “Licensing plan during implementation of new safe confinement project (NSC). Addition to the licensing plan during implementation of SIP projects at the Shelter SSE Chernobyl NPP. Phase 2” (approved by SSE ChNPP on 19.05.05) [22] (hereinafter – NSC-LP). This licensing plan was completed with the changes concurred with the RA (LD 11-05 and LD 02-07 Notes).

The main stages of the licensing process during NSC project implementation are Agreement of licensing documents (in compliance with the requirements of acting Ukrainian legislation to their composition and contents) and obtaining from SSE ChNPP Authorization/License for implementation of specific types of activity.

Table 1.6-1 provides the general scheme of the licensing process during implementation of NSC CS-1. The detailed schedule of the licensing plan during NSC CS-1 Detailed Design is provided in section 4.6.

In order to obtain Concurrence/Authorization/License within the schedules of works it is necessary to allow time for each Concurrence/Authorisation/License in accordance with recommendations of [22].

To ensure an efficient licensing process (reduction of timescales for licensing, timely resolution of open questions on safety issues, etc.), [22] envisages in the process of design and project implementation of CS-1 an “early interaction of SSE ChNPP/SIP-PMU/CS-1 Contractor with the Regulatory Authorities and their expert organisations”.

Table 1.6-1. The licensing process scheme for CS-1

STAGE OF ACTIVITY OF OPERATING ORGANIZATION	BASIC DOCUMENTS TO BE SUBMITTED TO THE REGULATORY AND SUPERVISING AGENCIES	STAGE OF LICENSING PROCESS
Preparation of infrastructure for construction of the NSC CS-1	Sections of working designs related to safety: safety assessments, environmental protection, sections for fire, industrial safety, and protection of labour.	Agreement/ permit for construction
Start of designing	Documents on important design criteria and requirements which have not been established in the NSC FS (CD)	Agreement
Early Design Stage	Concept Design Safety Document, the purpose of which is provided in section 1.7.	Agreement
Development of Design / Working Design/Separate WEP	The design of the first NSC commissioning stage, it is proposed to develop, review and concurred with the regulatory and supervising authorities in sequence in parts: • Part of NSC design including the basic construction; • Design of the first commissioning stage of the NSC stage as a whole, including the above-stated part, and also the design of NSC technological life-support systems and monitoring of NSC condition. Regulatory and supervising authorities also propose to separately review and concur: • Working design for the temporary foundations of the sliding pathways and assembly area until the design completion for the basic construction, providing that the inter-consistency between the designs of temporary foundations, permanent foundations and basic construction is demonstrated; • Working design of the ventilation stack dismantling. The process of development, revision and concurrence of NSC CS-1 design in parts and there corresponding justification, demonstrating the minimisation of risks connected with the terms of NSC	Agreement and Individually written permission for building / assembling / dismantling of VS-2

STAGE OF ACTIVITY OF OPERATING ORGANIZATION	BASIC DOCUMENTS TO BE SUBMITTED TO THE REGULATORY AND SUPERVISING AGENCIES	STAGE OF LICENSING PROCESS
	CS-1 design implementation is represented in Section 4.6. Regulatory and supervising authorities must decide regarding feasibility of the above-mentioned revision of CS-1 design in parts. Therefore, the following basic licensing documents should be developed: • NSC SAR, EIA and SCR initially developed and submitted for review by the Regulatory Authorities as a part of the first NSC commissioning stage (or its parts included in the above-mentioned parts of the design, except for the vent stack deconstruction design). • Working designs with safety assessments included for implementation of works on strengthening and sealing breaches of the existing structures, which will be part of the NSC framework structure. • Technical Decisions on new Design Criteria and Requirements or on Initial Data; • Safety assessment of the working design of the VS-2 removal is developed in case of separate review from NSC SAR, EIA and SCR. • Technical specifications for equipment, systems related to radiation, nuclear, fire and industrial safety. They shall be reviewed and concurred by regulatory and supervising authorities as a part of or based on the approved design/working design. • Safety sections of individual WEP as required according to [22]. • For works on strengthening and sealing of the existing structures that will form the NSC enclosing structure, technical decision and working design are provided with safety assessment. The employer develops the above documents.	
Commissioning of NSC CS-1(its components)	Technical decisions on commissioning and Programs of commissioning of CS-1 facilities, systems and equipment with corresponding safety justifications.	Individual written permission for

STAGE OF ACTIVITY OF OPERATING ORGANIZATION	BASIC DOCUMENTS TO BE SUBMITTED TO THE REGULATORY AND SUPERVISING AGENCIES	STAGE OF LICENSING PROCESS
	Regulatory and supervising agencies may review and concur above documents consistently for separate facilities, systems and equipment. The sequence of commissioning for implementation of facilities, systems and equipment and start of their operation, as well as consecutive lists of the above-stated documents subject to concurrence with regulatory and supervising authorities will be determined in the design of the first NSC commissioning stage. In order to obtain a special Authorization to proceed with commissioning of NSC CS-1 (or separate structure, system, equipment, as NSC components, including OS) the following documents are submitted to the regulatory and supervising authorities in accordance with the NSC-LP and the effective legislation of Ukraine: • Inspection Deed, • Working Commission Deed in accordance with [23], • Commissioning Program, • Sanitary Passport in accordance with [24], • Authorization by SDU MIS for commissioning of highly hazardous facilities, machines, mechanisms and equipment in accordance with [25], • Technical decision on commissioning, • Operation documents.	commissioning
Operation of NSC	For receiving the license for the operation of NSC, as part of CS-1 OS, the documents are submitted into Regulatory and supervising authorities in accordance with the current legislation of Ukraine and LP NSC. • The updated SAR, EIA and SCR (if required) and the results of commissioning of the systems, structures and equipment of the first commissioning stage;	License for the operation of NSC

STAGE OF ACTIVITY OF OPERATING ORGANIZATION	BASIC DOCUMENTS TO BE SUBMITTED TO THE REGULATORY AND SUPERVISING AGENCIES	STAGE OF LICENSING PROCESS
	• The technological regulation of the NSC operation (including OS) taking into account the commissioning of systems, structures and equipment of the first commissioning stage; • Changes to the Sanitary passport in accordance with [24]; • Inspection Deed; • State Committee deed; • Authorisation of SDU MIS for commissioning of highly hazardous facilities, machines, mechanisms and equipment in accordance with [25] • Technical decision on operation; • Other documents, as required by Ukrainian legislation for obtaining License from SNRC. Prior to issuing a new License for NSC operation within the valid License, the permissions for operating separate structures, systems and equipment of the first NSC commissioning stage can be issued. For obtaining these permissions, the above-listed documents, in the part dealing with this structure, system or equipment, are submitted to the Regulatory and supervising authorities (instead of State Committee deed, a Working Committee deed can be submitted). For implementation of works on strengthening and sealing breaches of the existing structures, which will be part of the NSC framework structure updated parts of NSC SAR, EIA and SCR are submitted for obtaining the permissions for operations.	Individual written permissions for operation of the NSC CS-1 constituents

1.7 AIMS AND TASKS OF THE NSC-CS1 CONCEPT DESIGN SAFETY DOCUMENT

Purposes and tasks of the CDSD are stated in [26].

In Document [26], the International Advisory Group (IAG) is reported to have proposed a specific approach for the minimization of "regulatory risk" during implementation of NSC CS-1 Design.

Minimization of "regulatory risk" will be carried out based on the following four steps:

4. CDSD development prior to start the Detailed Design;
5. Regular interaction between ChNPP, NOVARKA, the RA and their expert organizations (EO) during the whole process of engineering, including early design stages;
6. Use of relevant approach by the Customer and Contractor for preparation of justifications of the highest quality, safety and prompt submission;
7. Preparation of the detailed regulatory schedule for the whole design where all key regulatory stages will be displayed, safety related documentation that should be prepared for each stage and time of these documents presentation will be stated.

1.7.1 PURPOSE AND SPHERE OF APPLICATION FOR NSC CS-1 CDSD

The purpose of CDSD is presentation of agreed basis for further work on NSC detailed design.

The CDSD will form a basis of organisation of interaction with the Customer/Contractor on NSC CS-1 and Regulating Authorities / expert organizations during NSC CS - 1 Detailed Design. After concurrence from the Regulatory Authorities, the CDSD will be a robust design basis for the NSC CS1 Design.

The CDSD includes:

- Functional specification of NSC CS - 1;
- Systematized design criteria and requirements and initial data for NSC CS - 1;
- Analysis of regulatory/normative base applicable for NSC CS - 1 designing;
- Methodology and approach of the NSC CS - 1 Contractor to perform design criteria and requirements;
- Procedure of designing and detailed licensing process at NSC CS - 1 designing, in particular, with indication of the stages for interaction with RA at early design stages.
- Information on basic technical solutions and design solutions for planned NSC CS-1 based on Technical proposals.

CDSD, changes and additions to CDSD made during development of the design till its completion are subject to concurrence by RA. It concerns in particular additional design criteria, important initial data, application of documents of other States.

In order to supersede, in some areas, the shortcomings in initial data, design criteria and requirements and functional specifications available, NOVARKA has developed and pre-justified additional items of information which are included in the CDSD. These pre-justifications rely on good engineering judgement, comparison with similar reference facilities and / or preliminary calculations.

1.7.2 PLACE AND ROLE OF CDSD IN THE LICENSING PROCESS FOR NSC CS-1

The CDSD plays a role of the first step in the licensing process on NSC CS-1 Detailed Design. This document is considered as the document whose aim is to provide design safety criteria, design norms, safety rules and standards and methodologies, which will be applied for evaluation of the project for compliance to the norms, rules and standards of the state Regulatory Authorities.

The current CDSD reflects the normative framework applicable at the present time. The pursuing list of norms, codes, regulations and standards as well as the criteria and requirements which are extracted from them might be subject to evolution during the Detailed Design. If any new criteria or requirements have to be applied or are replaced, they will be subject to prior agreement with the Regulatory Authorities. The changes should be concurred in due time prior to submitting the NSC CS-1 design, SAR, EIA and SCR. For this operation Technical Decisions will be drafted and submitted for review as stated in section 4.6.3.

According to the Licensing Plan [14], the CDSD also aims to propose a schedule of interfaces with the Regulatory Authorities, enabling frequent and timely review of the Design criteria, requirements and outcomes. This schedule and the justification that it limits for the regulatory risks are provided in section 4.6.

ATTACHMENT TO CHAPTER 1

A1.1 – REFERENCES

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