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Further implementation of the "Shelter“ transformation strategy - problems and perspectives

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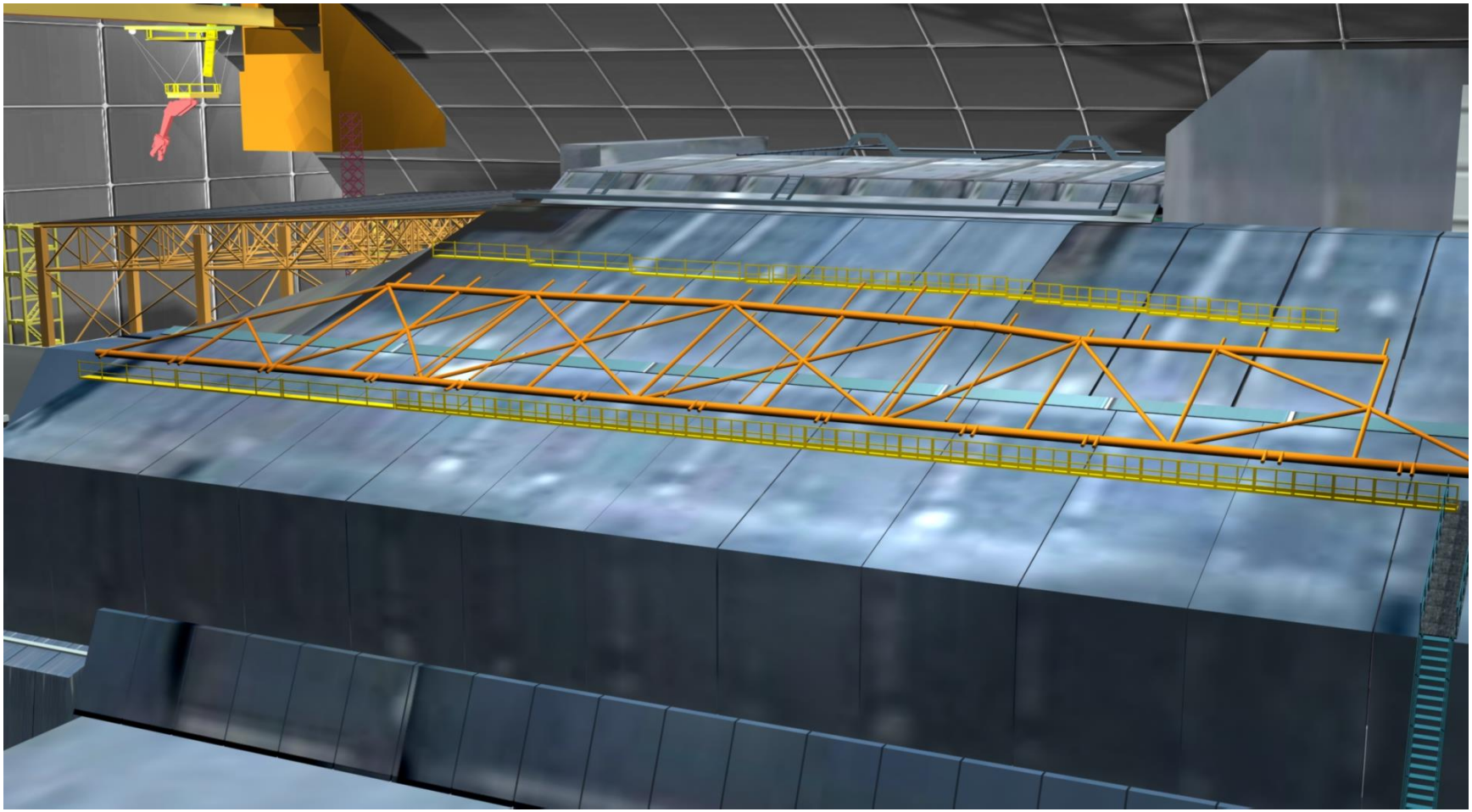
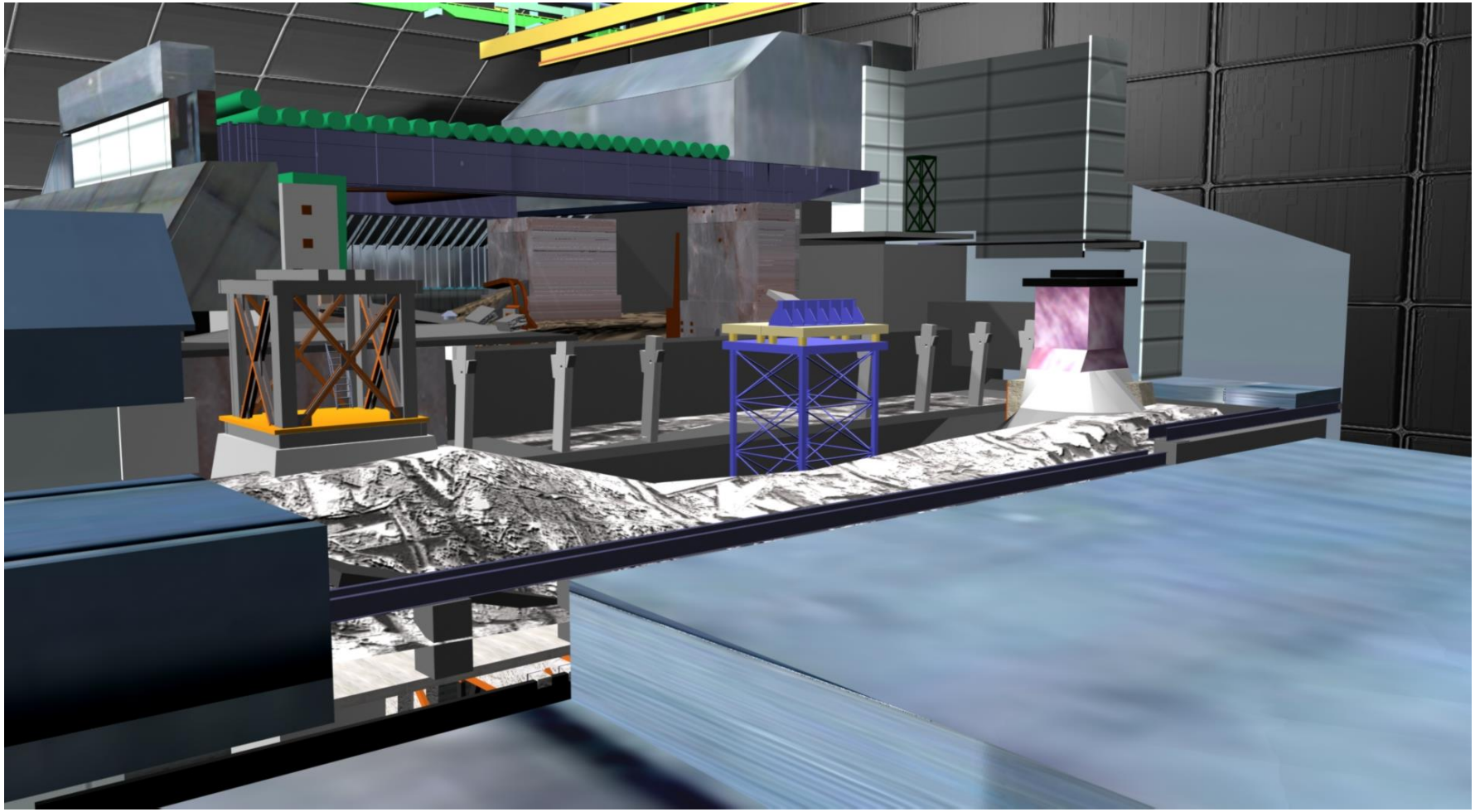
The Law of Ukraine "On general principles of future operation and decommissioning of Chernobyl NPP and transformation of the destroyed fourth power unit of this NPP into ecologically safe system" states that **"the confinement is a protective building, which includes a complex of technological equipment for the extraction of the materials, containing nuclear fuel, from the destroyed Chernobyl NPP unit , radioactive waste management** and other systems intended to carry out activities to transform this unit into an environmentally safe system and ensure the safety of personnel, population and the environment "

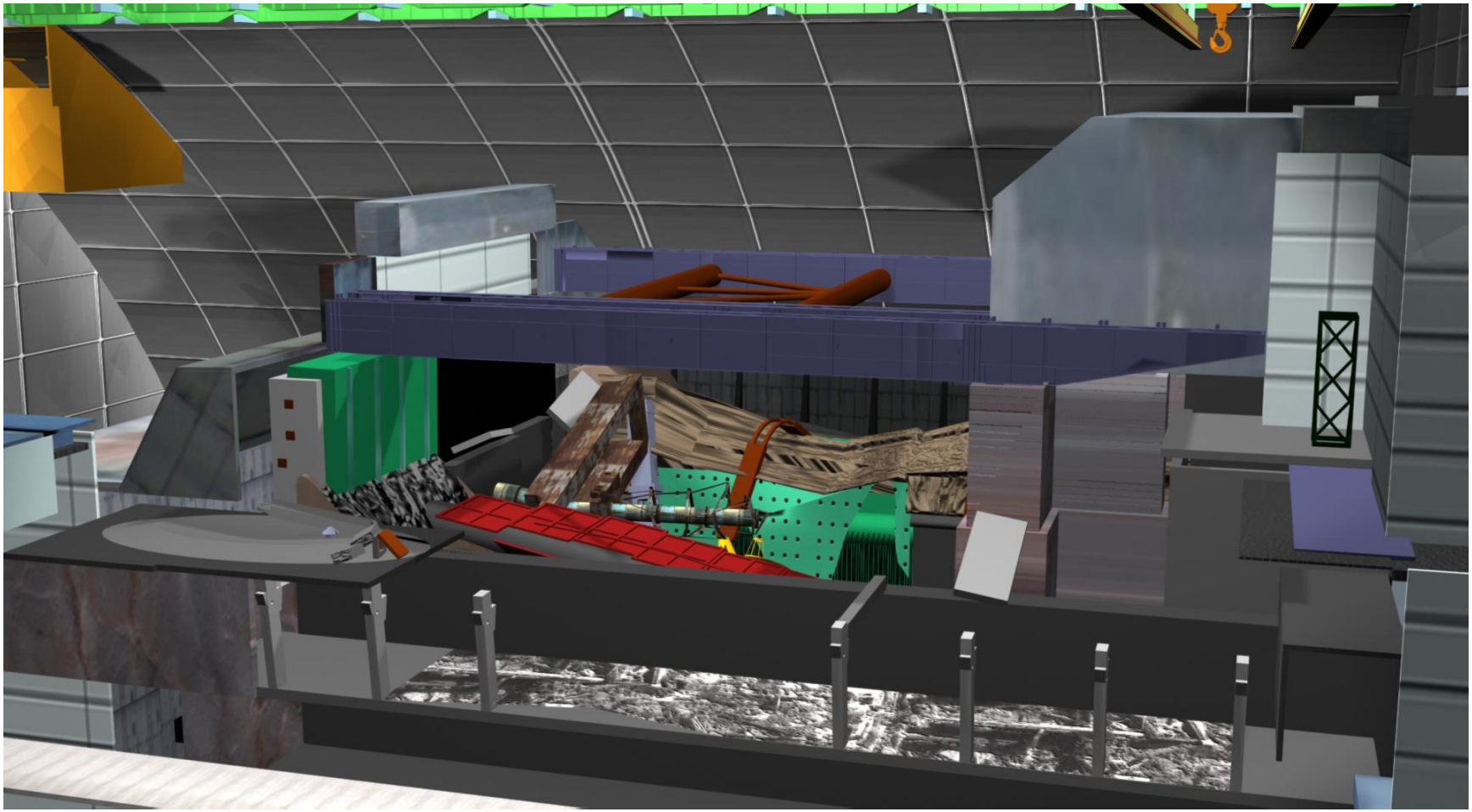
The initial OS state before the dismantling of unstable structures



The intermediate OS state



The OS state after the "early" dismantling



Problems at realization of stage of the unstable structures dismantling

The absence of the dismantling project, including the creation of an appropriate infrastructure (PC-2). Although initially in accordance with the "Strategy for the further implementation of the project NSC" of 2004 the PC-2 designing was planned to carry out in parallel with the PC-1 designing. To date, only the designed project on the connecting truss dismantle has passed the state expertise.

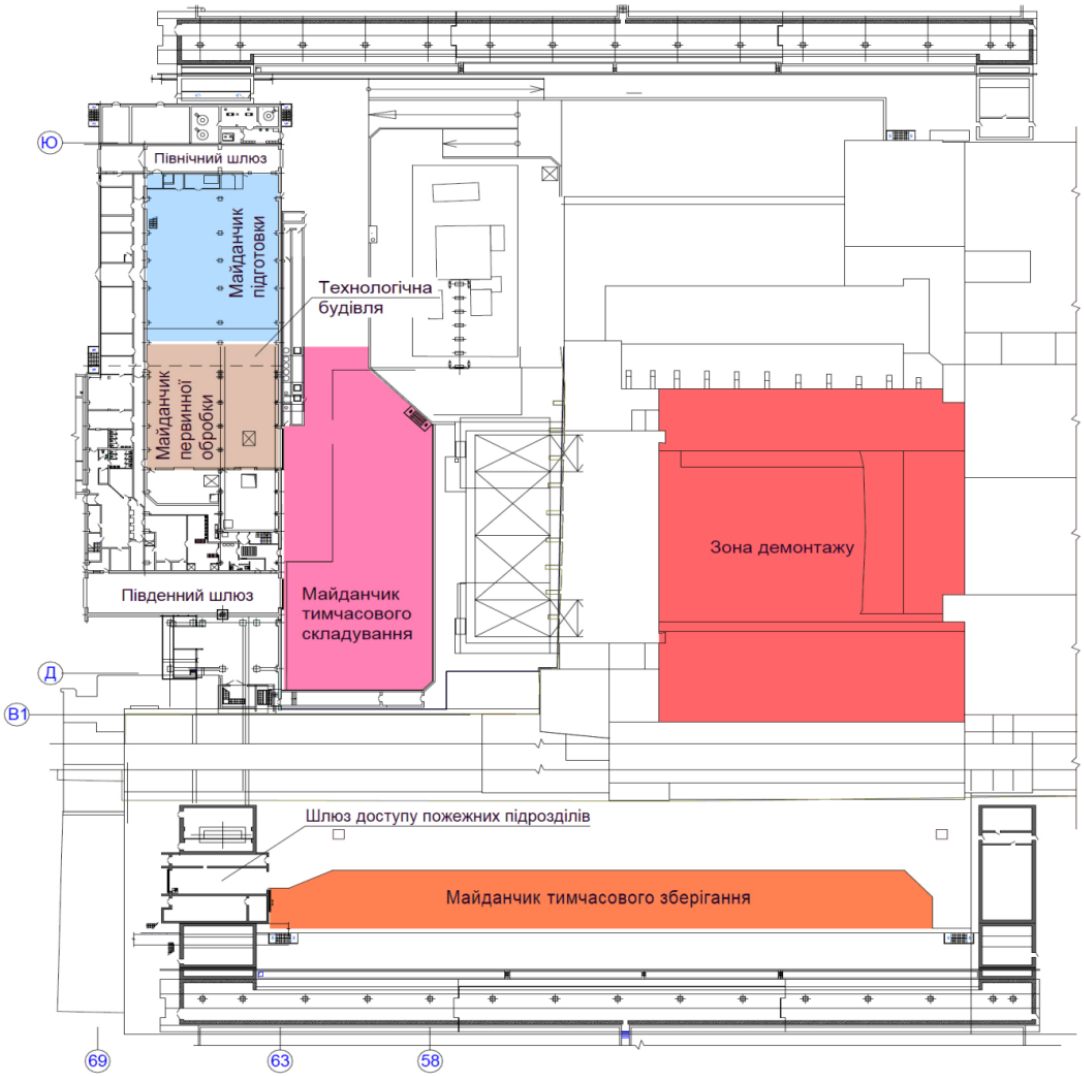
High probability of FCM and HLW finding at dismantling the logjam at DS and logjam over the room 805/3 (at the deferred dismantling).

High probability of potential accidents at the logjam dismantling.

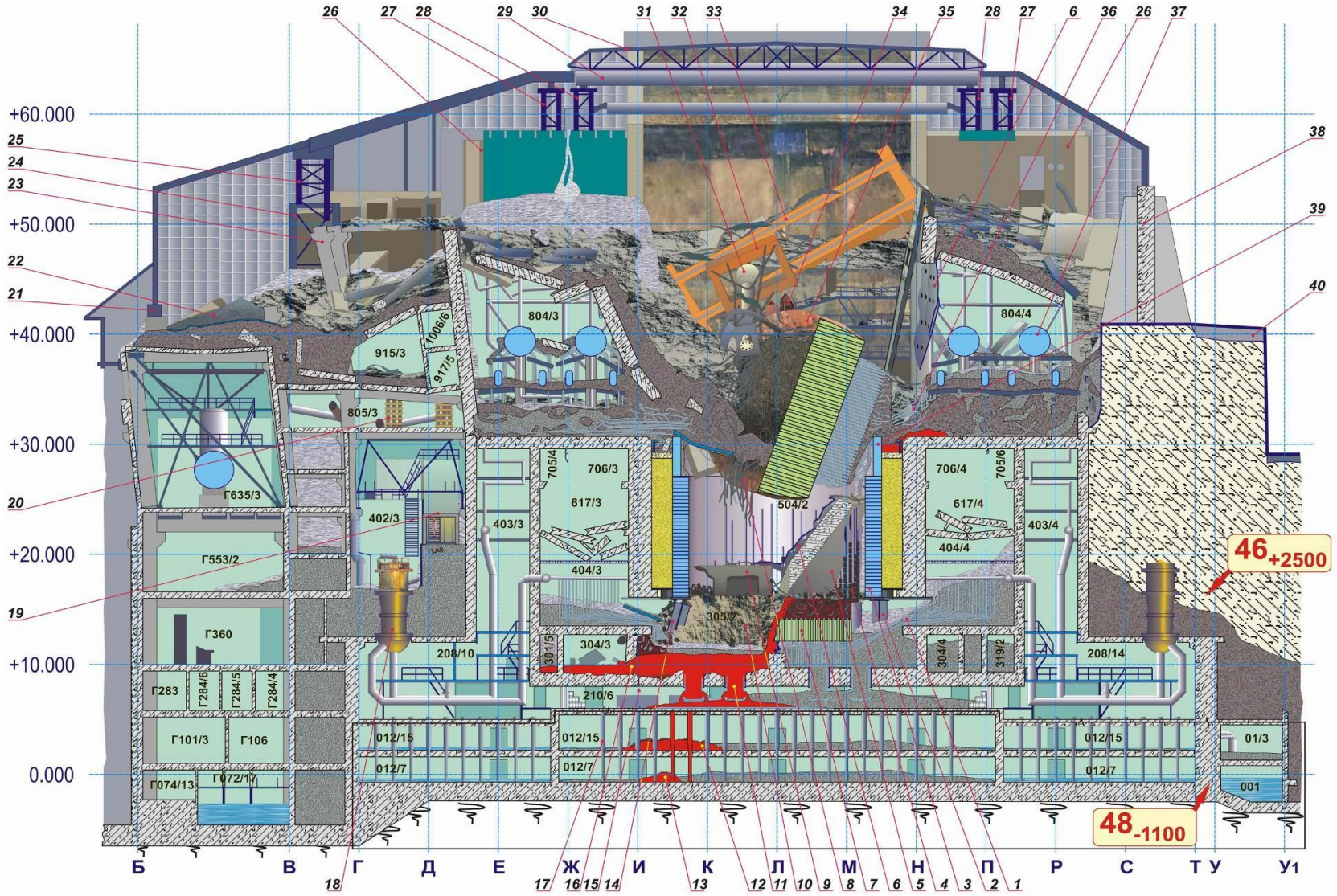
In the process of structures dismantling the MDSS and NGSSS will be decommissioned that will require the implementation of additional measures to ensure NRS.

High probability of unavailability of the infrastructure for the management of dismantled structures, though this problem is overcome by the use of the concept of deferred radioactive waste management, which involves the transfer of parts of dismantled structures, in particular reinforced concrete structures on the site for temporary storage.

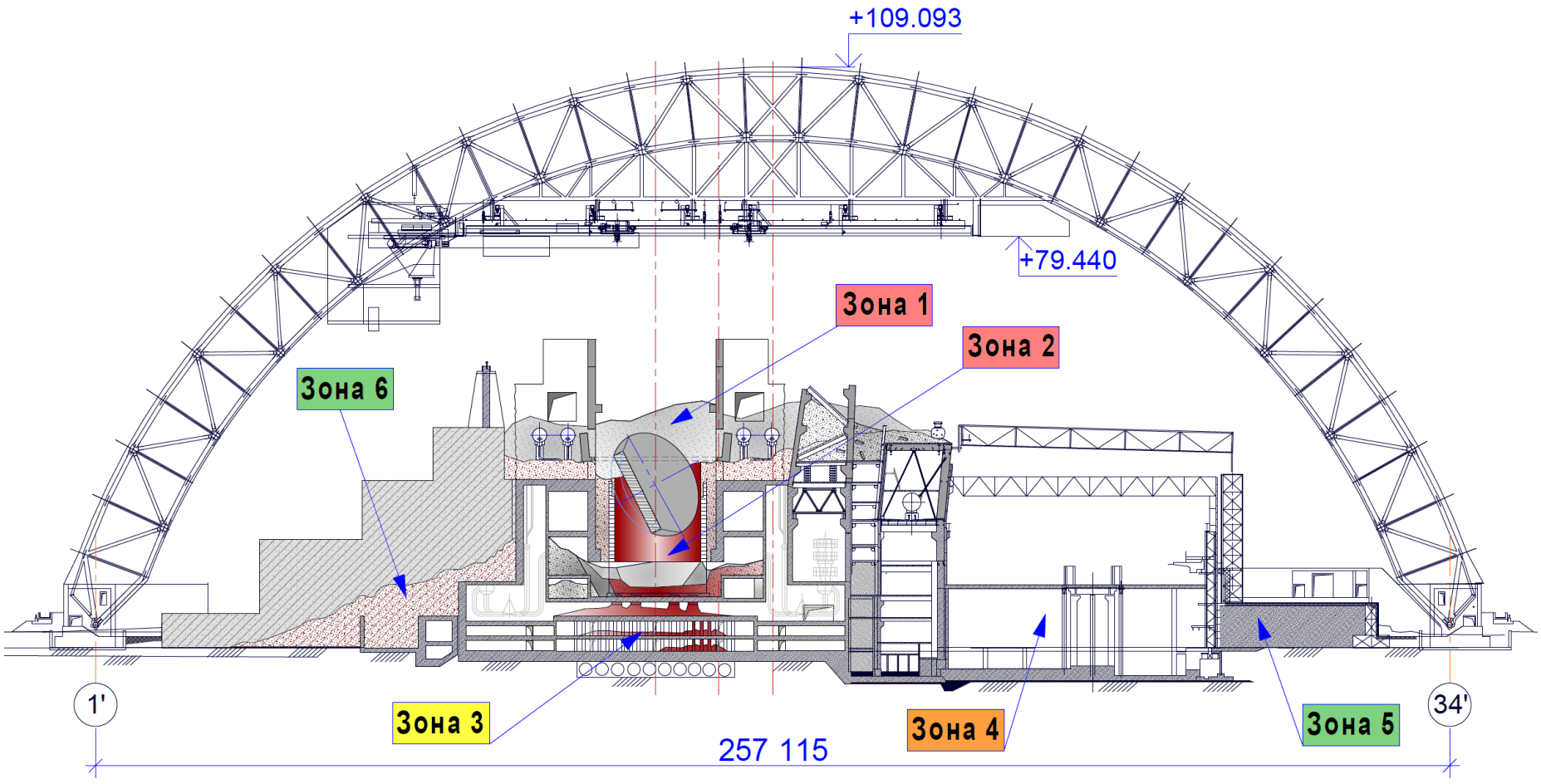
Objects (sites) within the NSC, at which the dismantling radioactive waste management will be carried out.



General view of the OS premises (section along the axis 46)



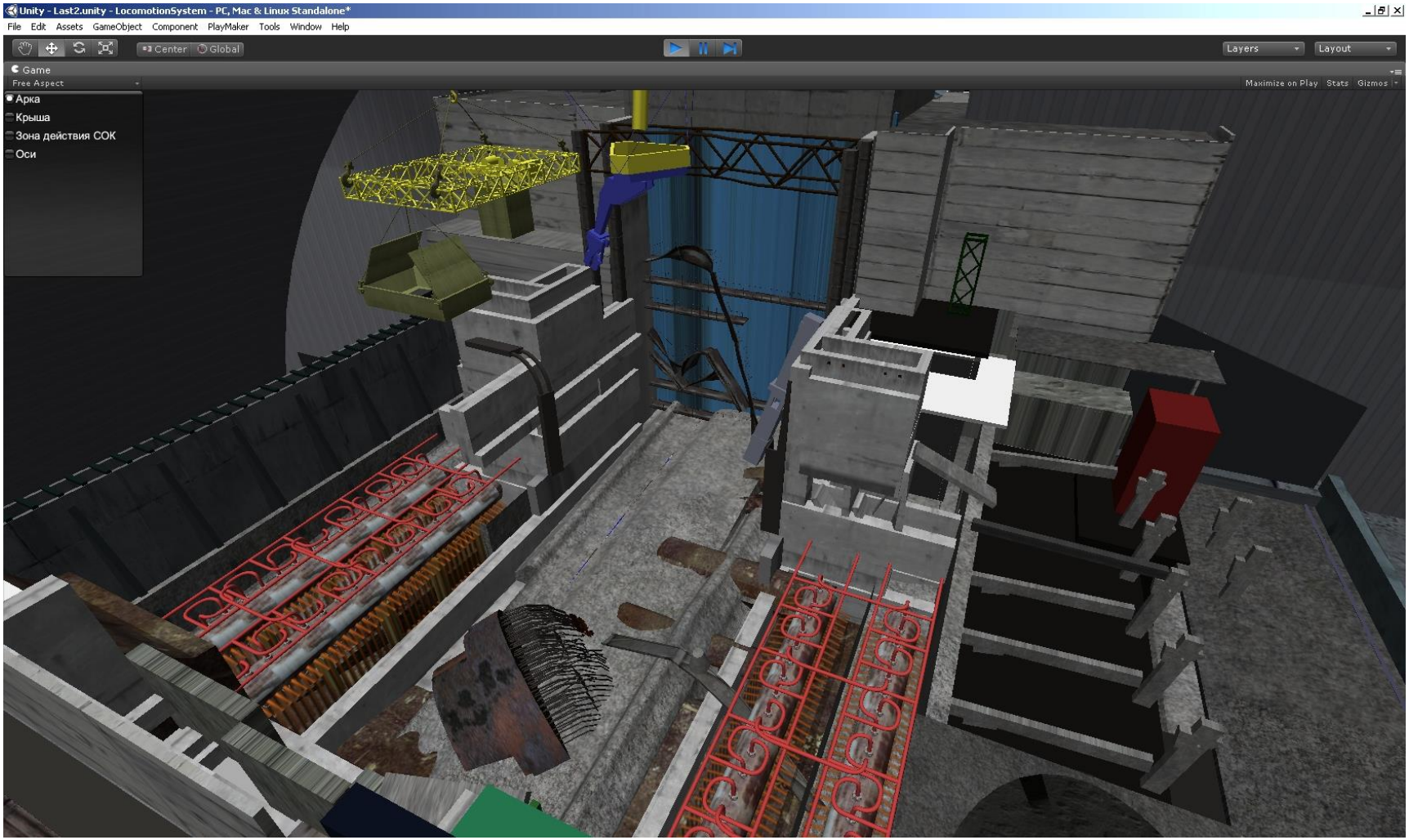
FCM extraction zones



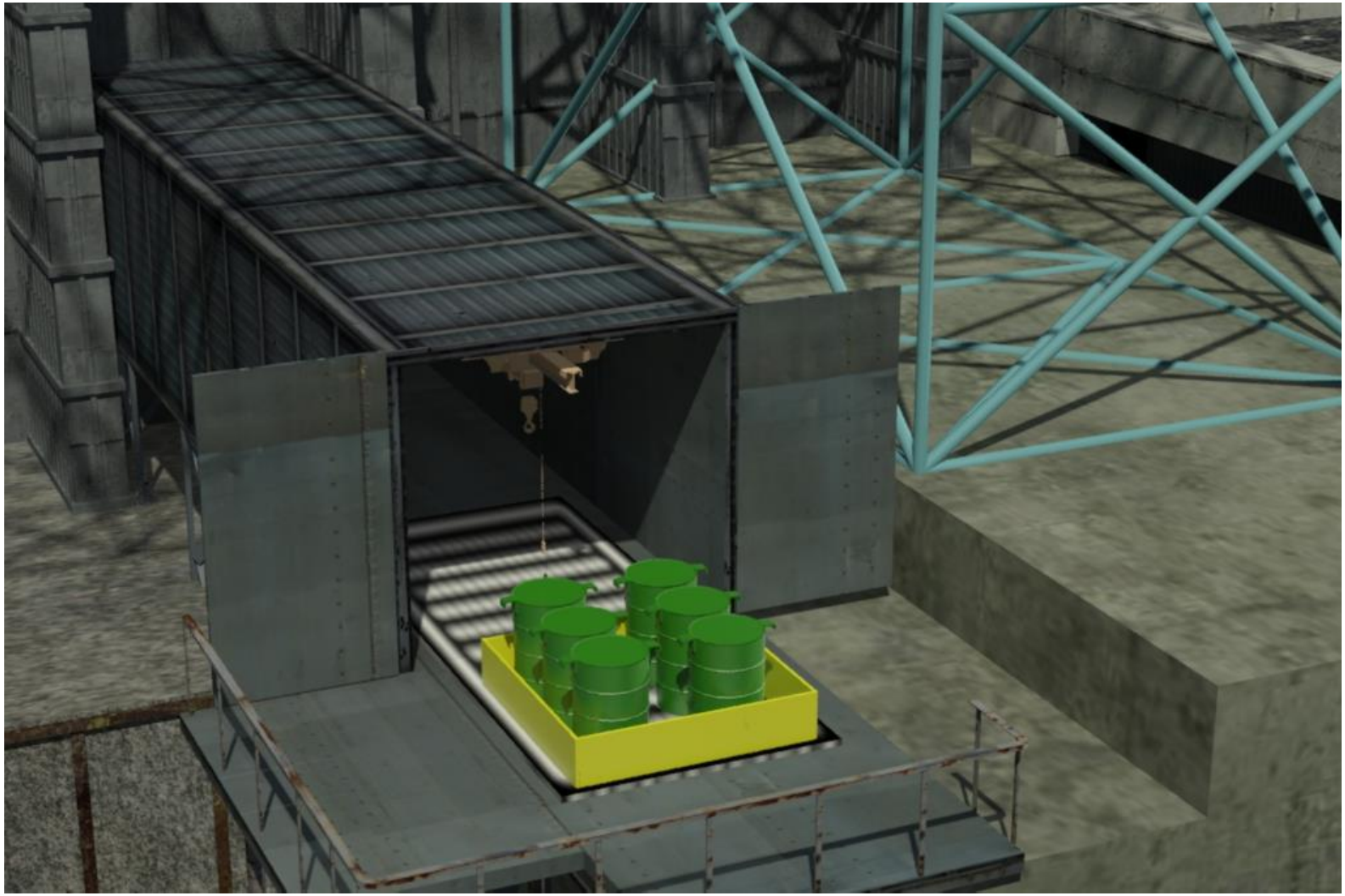
Difficulties in removing FCM from the zone 1

- Large amounts of FCM and associated waste;
- Difficult radiation conditions;
- The presence of a large amount of fuel dust;
- Possible presence of nuclear hazardous FCM aggregations;
- The presence of massive structures (scheme "E", unloading and loading machine, etc.), which cannot be removed entirely and it is necessary to provide the use of special remote-controlled units for their fragmentation;
- The presence of the large logjams. The number and characteristics of the FCM under them are unknown;
- The presence of graphite, which requires the use of special handling techniques.

Removing the FCM from the upper levels (zone 1)



The implementation of "horizontal" access to FCM aggregations at intermediate and lower levels (zones 2 and 3)



Scenario 1 - a full FCM extraction

- Considering the highest radiation and nuclear hazard of FCM aggregations located in zones 1 and 2, the activities on their removal is a priority.

- In the other zones there are no nuclear dangerous FCM aggregations, their impact on the radiation safety of the "Shelter" object is much smaller. Their extraction activities can be carried out at any time during operation of the NSC, provided that such activities will not hinder the extraction of FCM from the priority zones (zones 1 and 2).

Scenario 2 - Partial FCM extraction (option)

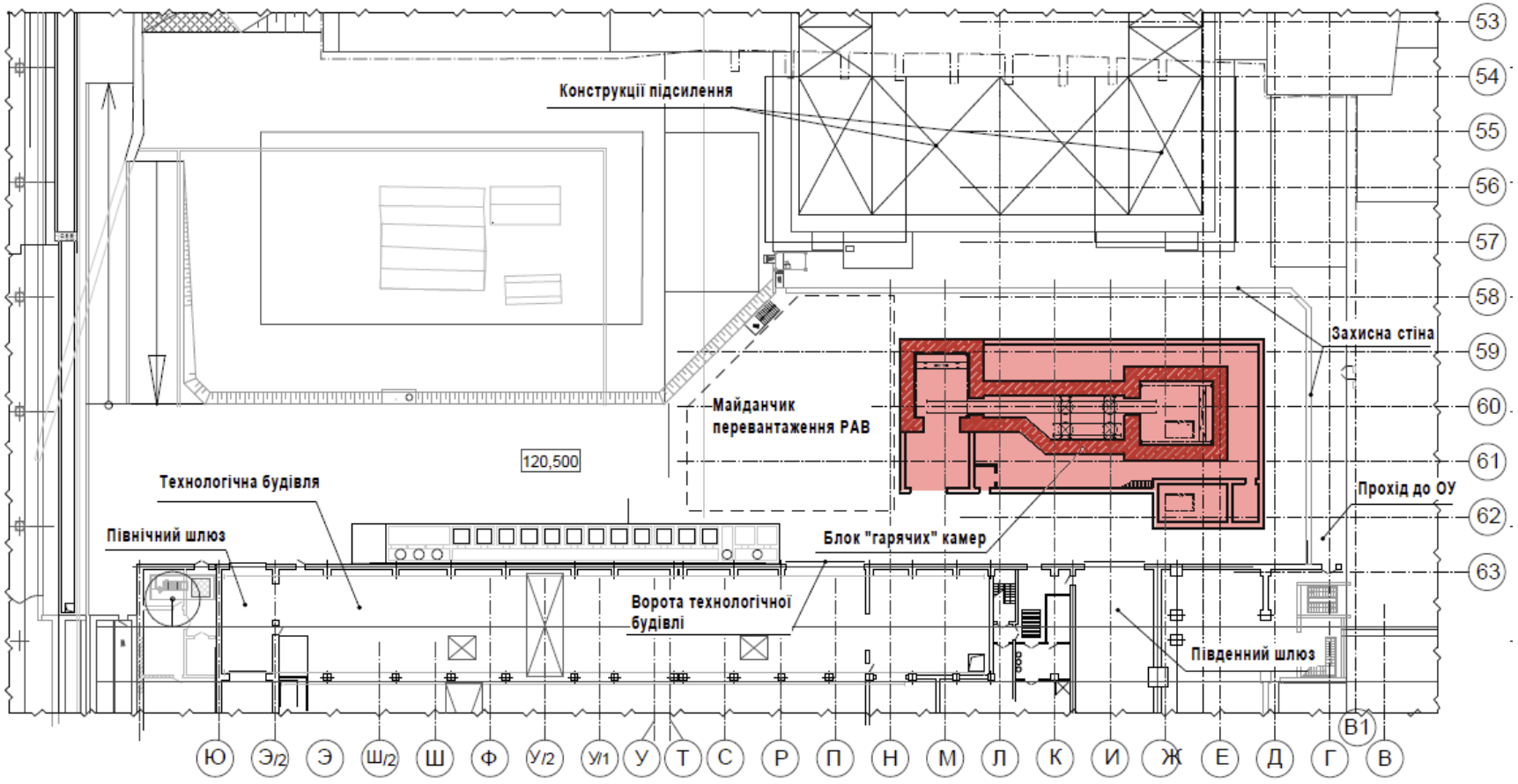
- Extraction the most dangerous FCM aggregations of zones 1 and 2 over a NSC life cycle;
- Deferred FCM extraction from zone 3 after NSC decommissioning;
- Disposal of less hazardous FCM aggregations in zones 4, 5 and 6 at the place of their location.

Selection of the OS final state

In our opinion, the most acceptable is OS conversion to **the storage of short-lived and part of long-lived radioactive waste**.

The permissible amount of long-lived radioactive waste is determined by the evaluation of repository safety, taking into account its location in a zone of special industrial use, unsuitable for people living

Example of hot cells block placing

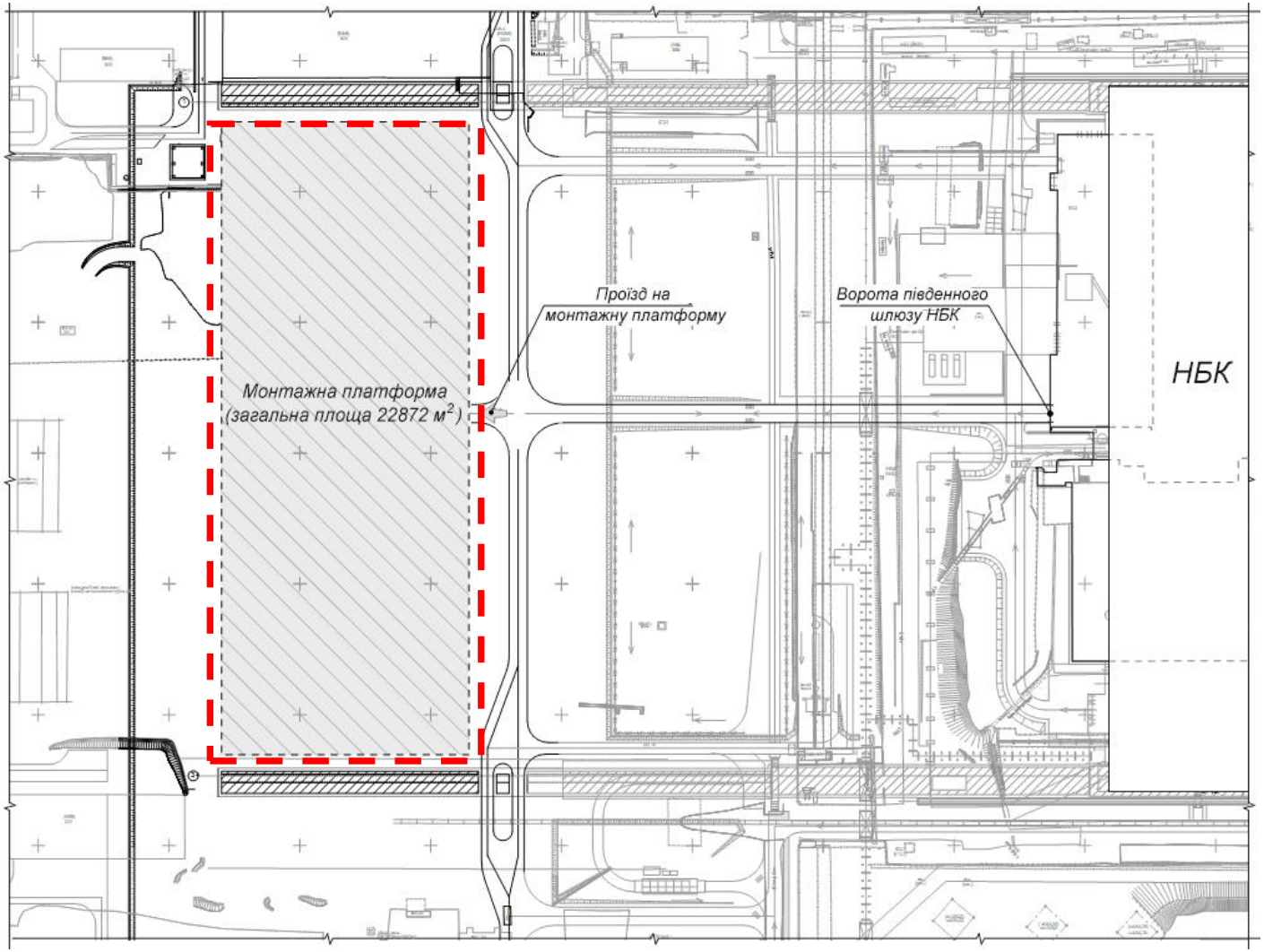


In the hot cells block there are should be carried out:

- Additional fragmentation;
- Sorting (separation FCM from other waste). This is a very important operation, taking into account the high costs of future FCM storage and especially their possible disposal;
- FCM loading to the primary packages and certification;
- Loading of primary packages with FCM to the protective container and its transfer for temporary storage.

In our view, the most reasonable is FCM conditioning in the form of containerization (without immobilization). In the future this will allow to perform the FCM processing, if it would be appropriate, given the enormous costs of geological storage (estimated - about $ 10 billion).

Potential site for the FCM temporary storage



The main directions of scientific and technical support

- **Selection and justification of measures to minimize the risks of the Shelter building structures caving in the process of conversion;**
- **Detailed study of FCM physical and chemical properties in order to predict their degradation process and to evaluate the dust generation quantity parameters;**
- **Development of methods for the characterization and initial sorting of FCM and other radioactive wastes in the process of extraction in the hard radiation conditions;**
- **Improvement of methods of FCM passportisation, including the direct methods of nuclear materials content measuring;**
- **Development of technical means for the implementation of unmanned technologies aimed for use in the OS conditions;**
- **Development of effective methods for decontamination of polluted structures and equipment;**
- **Assessment of the possibilities and efficiency of FCM processing in future after their extraction and temporary storage;**
- **Carrying out studies to assess the safety of different types of storage facilities for FCM and other long-lived radioactive waste interim storage and final disposal.**

All previous experience in Shelter stabilization activities, the NSC construction and other projects at the ChNPP indicates that it is possible to solve complex problems of liquidation of consequences of the accident at the ChNPP Unit-4 only through the joint efforts of Ukrainian and foreign experts, as well as the presence of a special fund to finance the planned works.

It is very important that the CNPP now initiate discussion of the problems of further transformation of the Shelter, and is making efforts to scientific, technical and financial support of the upcoming activities.

Thank you for attention!