question №1.

The document SNiP II-21-75 (Building Rules and Regulations) was valid at the time when reinforced concrete structures for Reactor Buildings of KhNPP 3 & 4 were designed. This document established requirements for the design, assessment of the bearing capacity and deformability of reinforced concrete structures: structural calculations were performed for two groups of limit states. For calculations of reinforced concrete structures it is recommended to use the cutset method with consideration of concrete and reinforcement stress-deformation diagrams.

Reactor Buildings 3&4 base mats and foundation slabs were designed as per documents in force at that time: SNiP 2.02.01-83 and SNiP 2.02.02–85 with requirements related to the depth of the compressed strata.

Steel structures for Reactor Buildings 3&4 were designed as per SNiP II-23-81 requirements.

SNiP II-7-81 was used for design of Reactor Buildings 3&4 against seismic impacts.

Climatic loads for Reactor Buildings 3&4 were accepted according to valid at that time SNiP II-6-74 as follows: wind pressure characteristic value – 38 kg/m^2, ground snow load characteristic value – 56 kgf/m^2.

question №2.
Results of survey of Kh 3-4 buildings and structures

As per Order of the Cabinet of Ministers of Ukraine № 281-p dated July 21, 2005, a survey and assessment of technical condition of Kh 3-4 buildings and structures were performed.

The survey was carried out by JSC «Kiev Research and Development Institute «Energoproekt» from 2006 to 2008 and consisted of the following stages:

- reconnaisance survey;
- survey of asbuilt (turnover) documentation;
- visual inspection;
- instrumental measurements;
- drawing conclusions of the survey results;
- development of proposals for repair and recovery works;
- forecast for durability (remaining life) of building stuctures.

question №2.
Final Conclusion based on survey results of buildings and structures (Report №43-473.211.016.OT00). №3

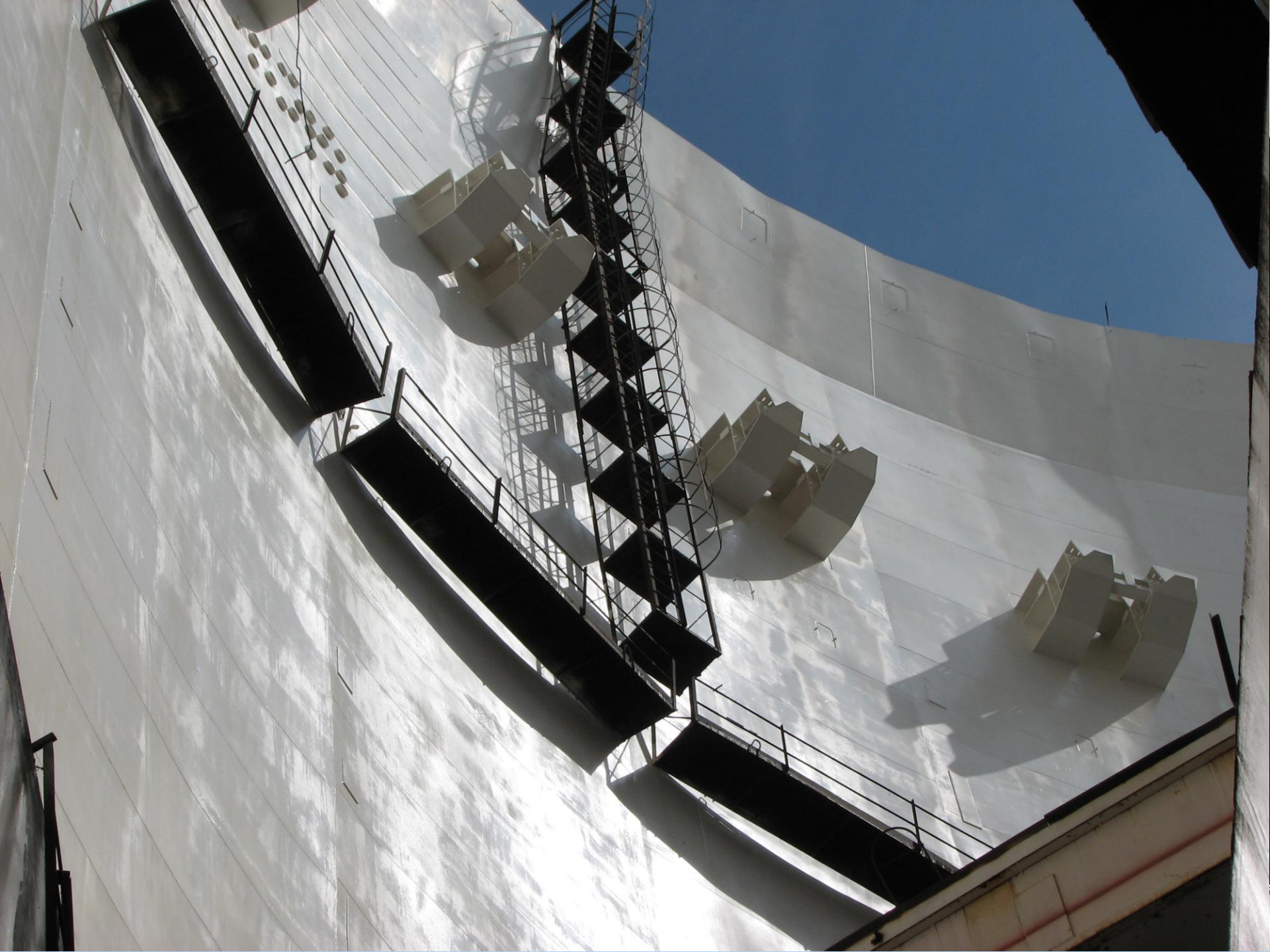
The following fully or partially mounted buildings and structures have been surveyed:

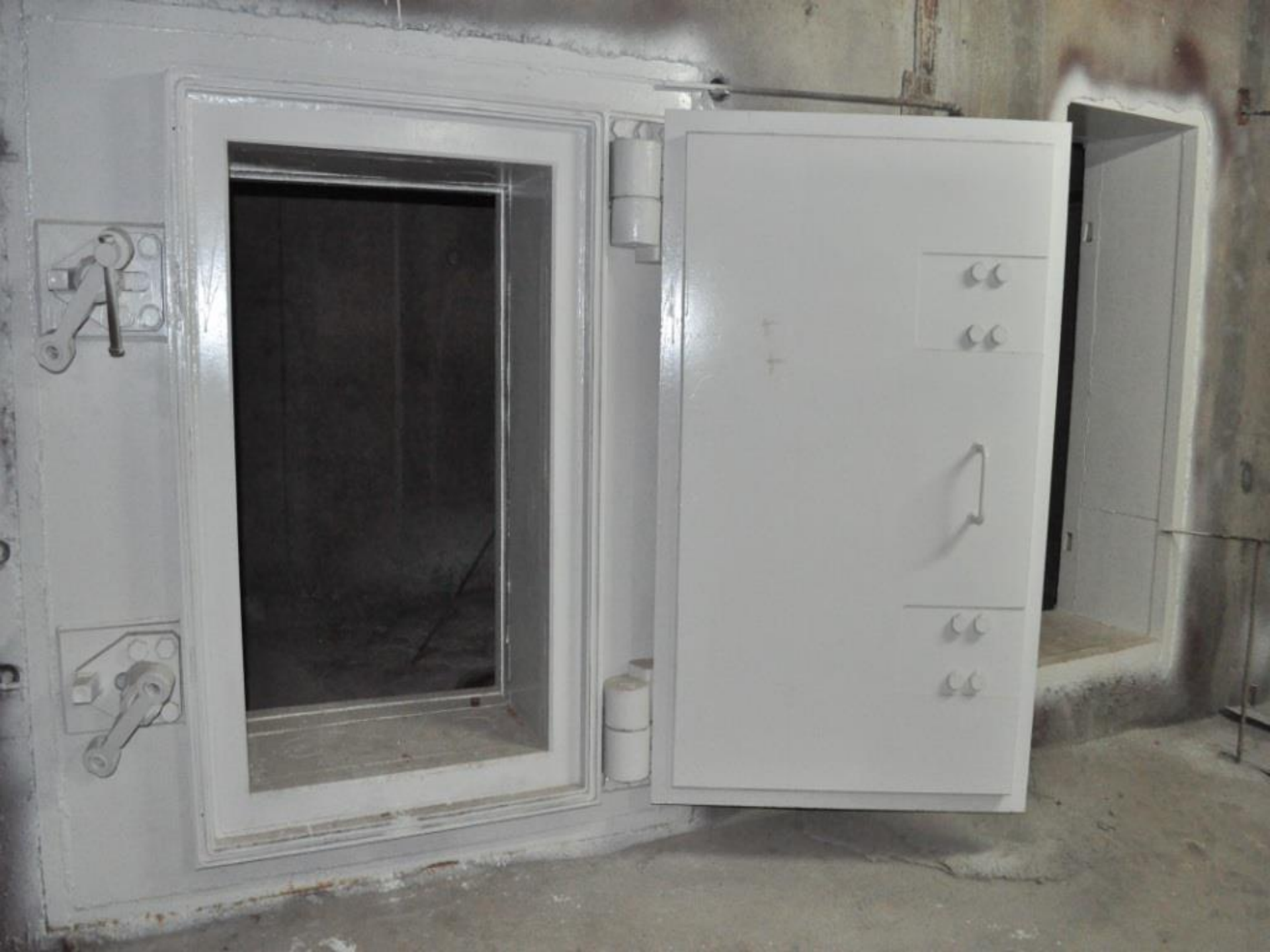
- reactor building - 3;
- turbine house - 3, incl. the turbine hall, the deaerator compartment, the addition for electrical engineering equipment;
- cooling water intake - 3;
- standby diesel-generator plant – 4 with fuel storage tanks;
- outdoor transformer-3 installed in the additions (incl. transformer roll tracks, oil cooler buildings and oil catch tanks);
- flexible foundations between turbine hall and open switch yard;
- gallery between turbine hall-2 and turbine hall-3;
- scaffold bridge for process pipelines between reactor building-3 and special building;
- scaffold bridge for process pipelines between turbine house -2 and turbine house-3;
- cable conduits with cable man-holes between the addition for electrical engineering equipment and cooling water intake -3;
- closed discharge channel with service building and siphon outlet;
- filter house (bottom);
- valve chamber;
- flexible connections.

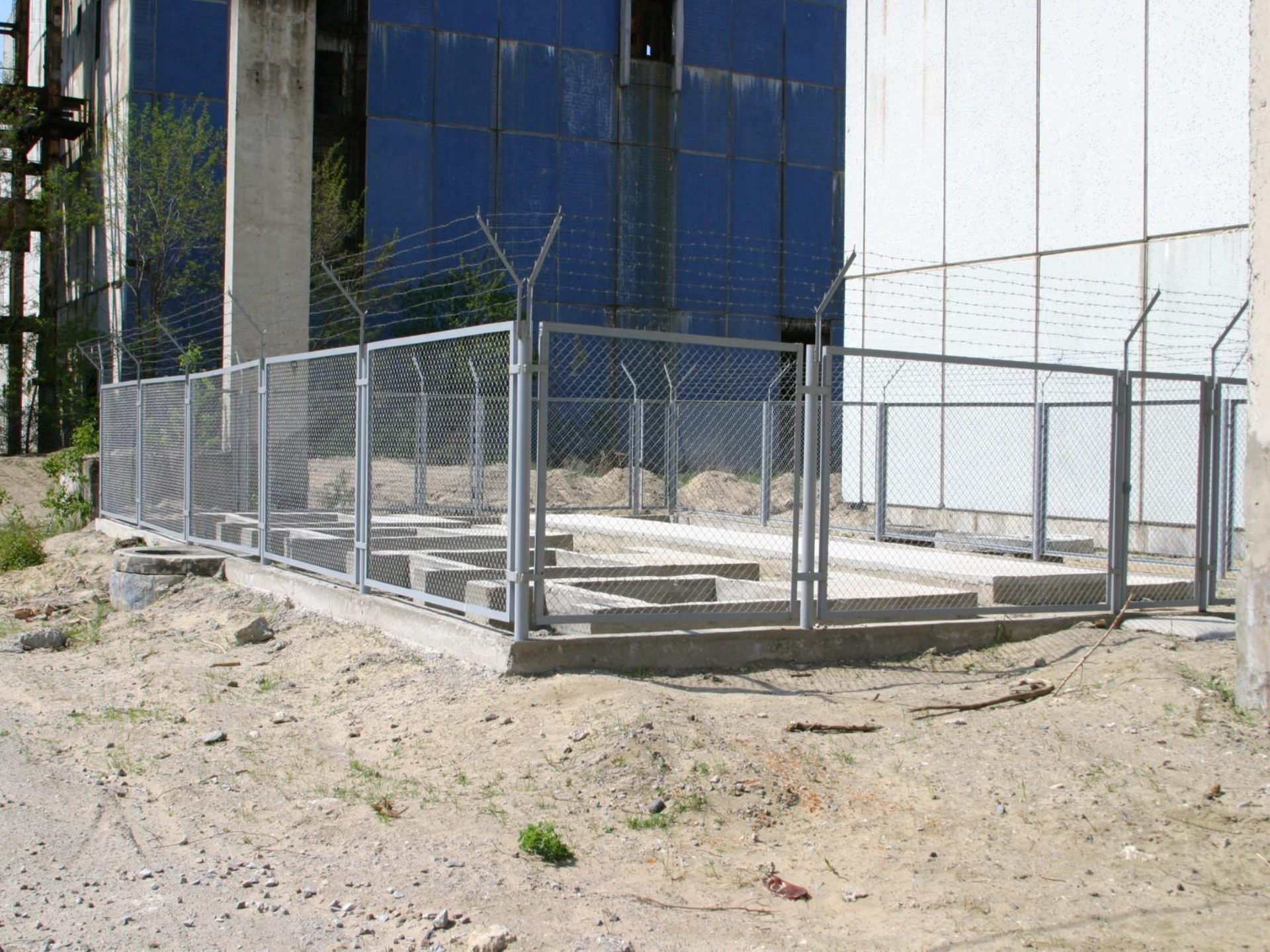
question №2.
Final Conclusion based on survey results of buildings and structures (Report №43-610.211.001.OT05). №4

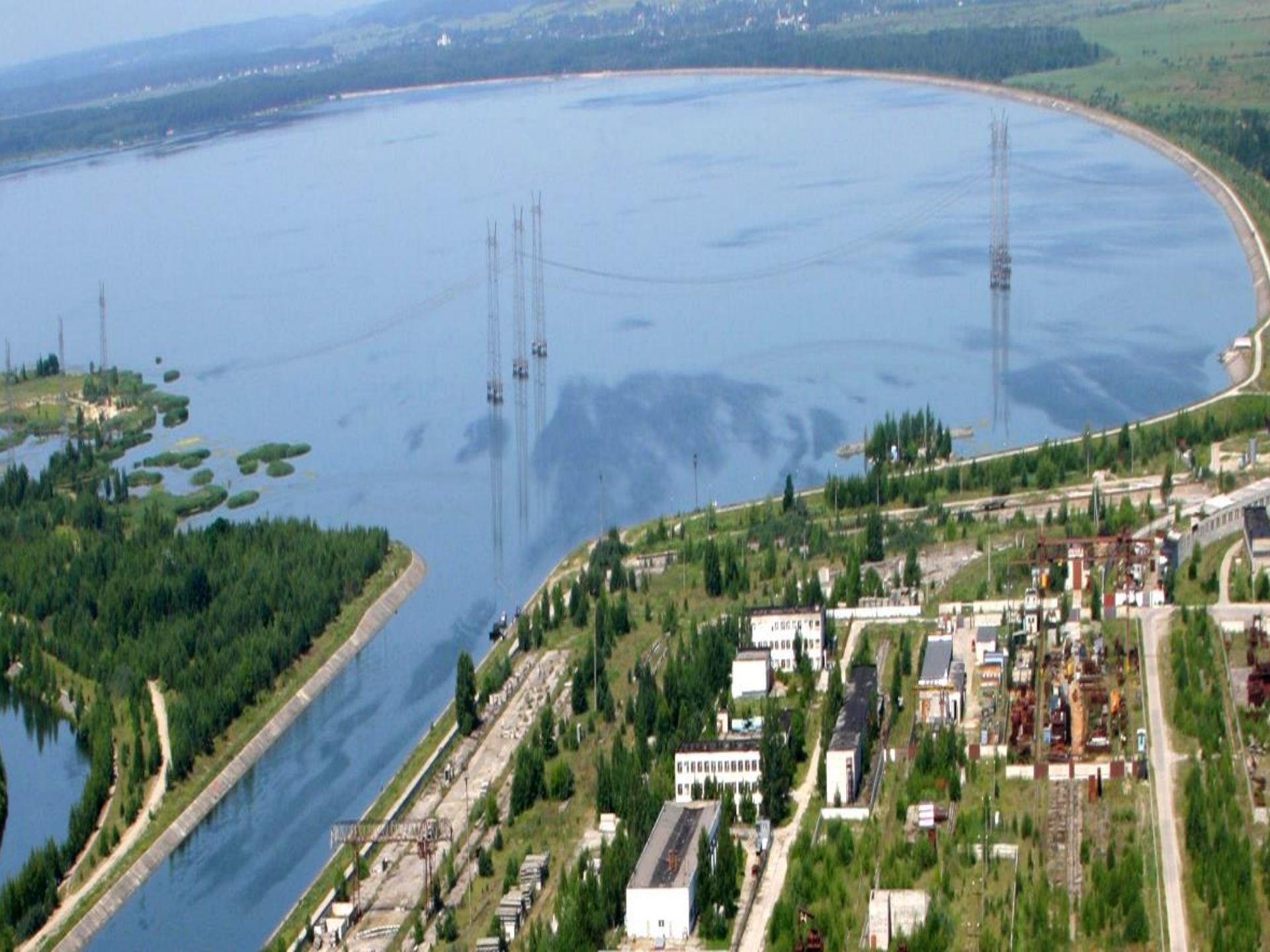
The following fully or partially mounted buildings and structures have been surveyed:

- reactor building -4);
- foundations for nitrogen receiver (near of reactor building -4);
- turbine house -4), incl. the turbine hall and deaerator compartment;
- cooling water intake -4;
- standby diesel-generator plant -5;
- outdoor transformer -4 with emergency oil discharge tank;
- flexible foundations between turbine hall and open switch yard;
- gallery between turbine hall-3 and turbine hall-4;
- scaffold bridge for process pipelines between reactor building-4 and special building;
- scaffold bridge for process pipelines between turbine house -3 and turbine house-4;
- valve chamber -4;
- closed discharge channel -4.
- cable man-holes near of standby diesel-generator plant-5;
- cable conduit between cooling water intake -4 and the addition for electrical engineering equipment.









question №2:
Conclusions on assessment and durability forecast for building structures (Report №43-473.211.018.OT00, №43-610.211.001.OT05). №3, 4

It was accepted within the life evaluation project that the age of structures was in average 20 years, and that they should maintain their characteristics in compliance with the design and regulatory requirements until KhNPP-3&4 decommissioning, including the period needed to complete the construction (which is estimated as 5 years), design life (estimated as 40 years), and decommissioning period (10 years).

Thus, the following assessment criteria were accepted for:

Lifetime assessment – maximum time from the erection of structures to the end of their lifetime, which is equal to 75 years;

Residual life assessment - maximum time from the end of the survey to Unit decommissioning, which is equal to 55 years.

Based on calculations and survey results, the lifetime assessment demonstrated that:

The strength of concrete for the most essential structures and reactor containment is ensured for the whole lifetime period of 55 years, without the consideration of remedial measures;

Average carbonation depth of the protective layer estimated by the end of lifetime provides the protective functions for the whole lifetime period of 55 years. In locations where the anticipated depth of the protective layer does not protect the steel reinforcement bars, adequate measures should be taken to slow down the carbonation process;

Based on the condition of reinforcing bars, the life of structures will be ensured after replacements of installed but not concrete-embedded reinforcement cages and protruding reinforcing bars.

Based on the condition analysis of building structures and life calculations, it was concluded that provided the package of remedial measures is implemented, KhNPP№ 3 & 4 buildings and structures will be reliably operated during 55 years.

question №3.

- The current regulatory framework used nowadays in the design of NPP buildings and structures has the following discrepancies with the previous requirements used at the time of the design development.

№	Previous requirements	Current Requirements	Changes
1	SNiP II-21-75 SNiP 2.03.01-84	DBN V.2.6-98:2009	Consideration of non-linear deformation model
. 2	. SNiP II-6-74 SNiP II-7-81	DBN V.1.2-2:2006	1 Characteristic value of wind pressure– 520 Pa. 2 Characteristic value of the ground snow load - 1330 Pa 3 Structural loads have been supplemented with specific hazards of shock wave, possible tornado, earthquakes, and extreme climatic hazards
3		PiN AE-5.6	New documents

question №3.

4		NP 306.2.208-2016	New documents
5		NP 306.2.141-2008	New documents
6	SNiP II-6-74	DBN V.1.2-14-2009	Consideration of Partial Safety Factor for the 1st group of limit states
7	SNiP 2.02.01-83	DBN V.2.1-10-2009	Consideration of design model “building – foundation –base mat».

question №4.

№	Loads and hazards	Regulatory Document
1.	Impacts on buildings and structures caused by static weight of structures and ground	
1.1	Weight of load bearing and building envelope structures	DBN V.1.2-2:2006
1.2	Ground weight and pressure	DBN V.1.2-2:2006
1.3	Fixed equipment loads	DBN V.1.2-2:2006
1.4	Weight of equipment filling components	DBN V.1.2-2:2006
1.5	Pressure of gases, fluids, and solids in vessels and pipelines	DBN V.1.2-2:2006
1.6	Re-deployed or replaced equipment loads	DBN V.1.2-2:2006
1.7	Vertical loads of overhead and gantry cranes with low characteristic value	DBN V.1.2-2:2006
1.8	Loads of movable lifting and handling equipment (with full characteristic value)	DBN V.1.2-2:2006

question №4.

2	External hazards	
2.1	Wind loads	DBN V.1.2-2:2006
2.2	Extreme winds	PiN AE - 5.6 DBN V.1.2-2:2006
2.3	Tornados	PiN AE - 5.6 DBN V.1.2-2:2006 RD 95 10444-91 IAEA 50-SG-S11A
2.4	Snow loads with low characteristic value	DBN V.1.2-2:2006
2.5	Snow loads with full characteristic value	DBN V.1.2-2:2006
2.6	Extreme snow	PiN AE - 5.6 DBN V.1.2-2:2006
	Ambient temperature range	
2.8	Temperature loads with low characteristic values	DBN V.1.2-2:2006
2.9	Temperature loads with full characteristic value	DBN V.1.2-2:2006

question №4.

2.10	Extreme ambient temperatures	PiN AE - 5.6
	Earthquakes	
2.11	Design basis earthquake	NP 306.1.02/1.034-2000 PNAE G-10-007-89 NP 306.2.208-2016 DBN V.1.1-12:2014
2.12	Maximum considered earthquake	NP 306.1.02/1.034-2000 PiN AE - 5.6 PNAE G -10-007-89 NP 306.2.208-2016 DBN V.1.1-12:2014
2.13	Subsidence and tilting of structures (effects of basemat deformations accompanied by a fundamental change in the ground structure related to its increased watering or by subsidence in underground mining areas or sinkholes)	PiN AE - 5.6 DBN V.1.2-2:2006
3	Industrial and other anthropogenic activity	
3.1	Shock wave due to an explosion possible at this or nearby facility, passing transport, etc.	PiN AE - 5.6 DBN V.1.2-2:2006
3.2.	Aircraft crash, including its parts and components	PiN AE - 5.6 PNAE G -10-007-89 IAEA 50-SG-S5

question №4.

4	Technology-related hazards / loads	
4.1	Normal operating conditions	PNAE G -10-007-89
4.2	Abnormal operational occurrences	PNAE G -10-007-89
4.3	Maximum design-basis accident	PNAE G -10-007-89 PiN AE - 5.6

question №6.

Ageing management programme (AMP) covers buildings and structures important to safety.

AMP purpose is to ensure ageing management of buildings and structures, to protect them from degradation within the limits established by nuclear safety standards and regulations during the whole lifetime period.

Now the AMP includes the Special Auxiliary Building due to the fact that it was designed according to the original project for 4 (four) power units of Khmelnitsky NPP.

All other buildings and structures for KhNPP 3&4 will be included in the AMP after their commissioning

question №7.
Completed renovation works at KhNPP units 3

Repair and recovery works:

The following repair and recovery works were completed:

Started in 2009; completed in 2013.

Completed activity:

Scaffold bridge for process pipelines:

- steelwork cleaning -6393 m2,
- steelwork priming – 6393 m2,
- steelwork painting - 6393m2(100%);
- repair of concrete structures – 100%.

Reactor building:

- steelwork cleaning -35444 m2;
- steelwork priming –34361m2;
- painting –31447m2 (98%);
- restoration of concrete surfaces –10700m2 (70%);
- installation of water scavenge pipeline;
- installation of temporary compressed-air pipeline.

question №7.
Completed renovation works at KhNPP units 3

3. Turbine hall:

•steelwork cleaning -52857m2,

•steelwork priming –52857m2,

•steelwork painting –52857m2; (99%)

•completion of temporary roofs;

•thermal circuit closure;

•repair of concrete structures –60%.

4. Standby diesel-generator plant:

•steelwork cleaning – 2695 m2;

•steelwork priming – 2695 m2;

•steelwork painting – 2695 m2; (100%)

•repair of reinforced concrete structures - 40%.

5. Cooling water intake:

•steelwork cleaning – 760 m2;

•steelwork priming – 760 m2; (100%)

•protection of reinforced concrete structures– 420 m2.(100%)

6. Scaffolds and galleries:

•steelwork cleaning -587 m2;

•steelwork priming – 587 m2;

•steelwork painting -587 m2 (100%).

question №7.
Completed renovation works at KhNPP units 4

Following the building and structures survey of KhNPP units 3 and 4 the «Programme for Completion of Repair and Restoration Works at KhNPP 3 and 4» will be developed.

question №8.
Equipment Available at KhNPP Storage Facilities that can be Applicable for Kh3/4

In 1987-1997, considerable amount of equipment was supplied to KhNPP site for construction of its power units. As per Kh3/4 Pre-construction Preparatory Measure Plan, KhNPP experts developed relevant programmes and performed examination, reconditioning, and preservation of equipment already installed at KhNPP 3 & 4 and equipment available at storage facilities. Reports were developed based on the examination results. The “List of Equipment Pre-delivered for Initial V-320 Reactor Project That can be Integrated into the New Construction Project for Kh3/4” and “List of Equipment Pre-delivered for Initial V-320 Reactor Project and can be Used for Auxiliary and Temporary Systems during Kh3/4 Construction” were developed and approved. At present, preservation and reconditioning works were carried out for equipment installed at KhNPP 3 and for big number of equipment available at storage facilities.

.

question №8.
Condition of Kh3/4 Equipment Available at Storage Facilities

KhNPP experts performed previous review of documentation stored in archives of Logistics Department for equipment applicable for further use. The review demonstrated that not all manufacturing documentation was available.

Works are in progress to compile a package of documents *(lists of equipment, terms of references)* for carrying out total revision of equipment previously supplied to KhNPP, and estimating its preservation cost. After having examined equipment, developed a database, taken decisions on its use and preservation, it will become clear which equipment needs repair or replacement of components, and renewal of manufacturing and installation documentation for its further use during Kh3/4 construction.

Examination reports were prepared where the following data were specified:

- ***Available manufacturing documentation per each item of equipment listing the missing documents;***
- ***Compliance of storage conditions with requirements in engineering documentation;***
- ***Metal inspection data for individual inspected components and units (conclusions, reports);***
- ***Scope and lists of materials required for preservation and reconditioning activities;***
- ***Decisions on equipment applicability.***

question №8.
Available Equipment at KhNPP Storage Facilities for Kh3/4

Today, assessment has been completed for 3715 items of equipment that was split into the following groups:

Group 1. **Equipment applicable for further use within Kh3/4 process systems;**

Group 2. **Equipment that can be used for Kh3/4 after missing components are supplied or can be included into replacement pool for KhNPP and other Ukrainian NPPs as a whole unit or by parts;**

Group №3. **Equipment not further applicable for its intended purpose.**

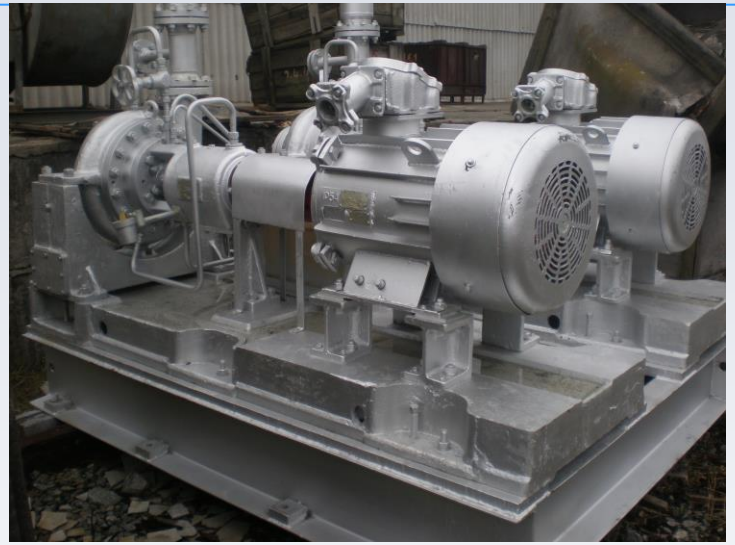
Group 1

Equipment applicable for further use within K3/4 process systems

Equipment	Quantity, pcs
Heat Exchanger	54
Hermetically sealed door, hatches	160
Hermetic penetration	45
Hydraulic Damper	158
Tank	8
Pressurizer	1
ECCS Tank	2
Bubbler	2
Steam Generator	4
Polar Crane	1
Refueling Machine and accessories	1
Reactor Coolant Pump	4
Primary Coolant Loop	4

question №8.
Equipment for K3/4 Available at KhNPP Storage Facilities

Equipment applicable for further use within Kh3/4 process systems



question №8.
Process Equipment Installed at KhNPP-3