

Zaporozhe NPP

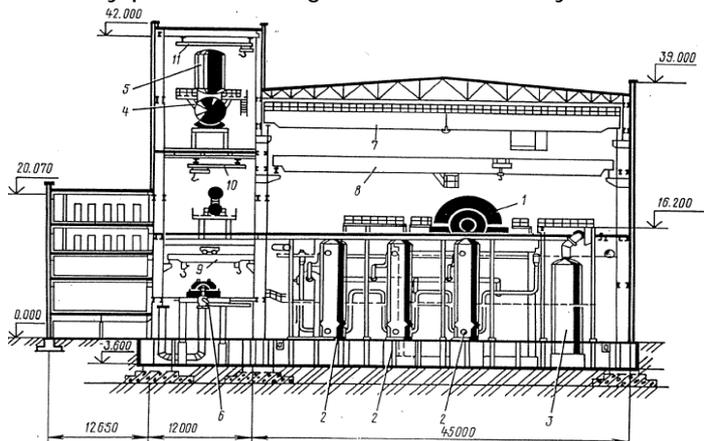
Fire Protection Coating of Structural steelwork in the turbine hall, Projects TACIS 1993 U1.03/93B, U1.03/94A, U1.03/95A, TACIS 1995 U1.03/95A1

Nuclear power plant	Zaporozhe NPP, Ukraine
Project reference	U1.03/94A
Project name	Zaporozhe Fire Protection Equipment,
IAEA safety issue	IH 2
Safety rank	III
Budget year	1993,94,95
Contract amount, Euro	2,948,214
EC endorsement of the contract	05.06.1996
Supplier	SVT
Current status of the project	Completed
Provisional acceptance certificate	08.12.1997

1. Background: Safety significance of fire protection in WWER 1000 NPPs

Zaporozhe NPP has 6 units with WWER 1000 type 320 reactors. Site construction started in 1979 and the first unit was commissioned in December 1984 with the major construction lasting 57 months. Units 2 to 5 were commissioned in one year intervals. Unit 6 was commissioned in autumn 1994.

The main building consists of the reactor building, turbine room, de-aerator bay and auxiliary power switchgear rooms. The layout of the turbine building is shown in fig. 1.



The fire protection system for ZNPP was designed to former USSR standards. The plant management is aware of the importance of fire safety.

In Unit 1, a major fire started in the turbine building electrical cable trays before the start of operation. In Unit 2, a station transformer fire caused some damage in the electrical building attached to the turbine building.

In the area of the turbine hall and the deaerator compartment the structure does not correspond to the fire protection requirements.

The buildings do not have their own outer wall with the required fire resistance in the area of the adjacent buildings. The roof construction of the turbine hall does not have a defined fire resistance time, due to the fact that the structural steelworks are made of non coated steel construction.

In case of fire the roof of the turbine hall would collapse very early, like during the fire at Chernobyl NPP. The turbine hall a unit 2 was badly damaged by a fire in the late 1991.

The goal of the coating is to improve the fire resistance of structural steelwork up to 45 minutes. This allows the fire brigade to extinguish the fire, because a time span of stability of the turbine hall is long enough to enable performing the necessary fire extinguishing actions.

#### Safety case:

Main safety functions affected:

- Controlling the power
- Cooling the fuel
- Confining the radioactive material

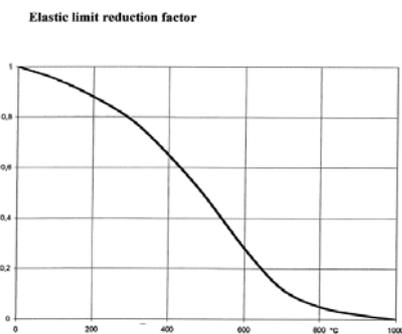
Safety rank of the issue: III

Justification of ranking:

This issue was identified as a deviation from NUSS 50-SG-D2. Insufficient protection against common mode failures due to fire would seriously affect level 3 of protection. Safety functions can be questioned on the loss of redundant trains during DBA scenarios.

## 2. Project safety impact

In case of fire, static loaded metal structures are not able to function in a proper way because at high temperature the steel elements fire resistance is very restricted and at 500 oC and above their durability is simply lost.



The objective of the project was to cover the walls and structures in the turbine hall with fire protective insulation layers, which under the influence of high temperatures (above 250 oC) bloat and significantly decrease heat flow from the fire to the protected structures. The aim of the project was to cover the wall and structure surfaces with a layer of coating that would keep the surface temperature within 500 oC for 0.75 h.

The safety concern was due to the weakness of existing structure in case of fire. The main 6.3 kV distribution system has four 6 kV main distribution boards per unit, which are energized either from the units auxiliary power transformers or from a set of startup transformers. These boards are located within an electrical distribution building, which is attached to the turbine hall. On the same floor additional switchgears are arranged for the distribution power on the 0.4 kV and the DC level.

According to the specifications and requirements of the Russian Federation and Ukraine the area of this floor is not considered to be a fire protection zone. A specific concern has been due to the fact that the emergency bus bars are being energized via the 6 kV main distribution boards mentioned above. In case of possible fire all the 6 kV main distribution boards may fail. Comparable cases of incidents have been reported from NPPs in the West, from Bulgaria and the Ukraine. Because of the loss of stability of the structural steel works in the course of the fire impact, these incidents caused finally a collapse of the turbine hall roof.

### 3. Planned outputs

Delivery and coating with passive fire protection materials for structural steelworks of the turbine hall.

This covering must provide the following parameters of fire resistance:

- for trusses: not less than 30 minutes
- for columns: not less than 45 minutes

During the accident, metal structures must not be subjected to any internal changes.

Besides that, the material must not be toxic and it must not interact with active medium. Required material must possess high moisture resistance and ability to stick to the surface of the protected material.

### 4. History of implementation

The projects were successfully implemented in Zaporozhe NPP within a short time, in particular the large project U1.03/94A Zaporozhe fire protection equipment at 2 948 k€ was realised by SVZ in the time from June 1996 till December 1997. The coating of the steel frame structures of the turbine halls with an intumescent material has been completed on all six units. Work was carried out by SVT Brandschutz company with strong support of the plant in the full scale according to the ToR. [MONIS 23296] of 29 May 1998

The timetable of the project implementation was as follows:

November 1995	Technical and financial evaluation of the bids. The European Commission (EC) selected the company SVT Branschutz as supplier.
December 1995	Contract negotiations between the Procurement Agent and the company svt Branschutz
May 1996	Contract for coating at units 1-5 signed by EC
June 1996	Contract for coating at units 1-5 signed by Goskomatom, ZAP NPP and the company svt Branschutz
June-July 1996	Coating unit 3
July-Nov. 1996	Coating Unit 2
Nov. 1996 - Feb 1997	Coating unit 1
February-May 1997	Coating Unit 4
May- Sept 1997	Coating unit 5
June 1997	The EC awarded the contract to the company SVT Branschutz for coating Unit 6
Sept-Dec 1997	Coating unit 6

The outputs achieved (fire protection improvement, urgently required spare parts) are appropriate to the NPP in scope and quality.

### 5. Scope and limits of the performed work:

The work included the following items:

*Supply and erection of scaffolds.* The scaffolds became property of UZNPP after completion of work in all units. Because of the continuous modifications of scaffolds, it

was necessary to have a large group of skilled scaffold workers under constant commitment. Gathering this group of scaffold workers took a long time.

*The coating of the structural steelworks* of the turbine hall was performed by joint venture between the German company svt Brandschutz and the Ukrainian company ASKEN. The supervisor was a member of the company svt Brandschutz and the other workers of the company ASKEN. The work was performed on a three cycle shift routine for work on critical paths. Other work was performed by a two cycle shift routine in order to assure the deadline as given with the underlying time schedule.

The coating was carried out by the airless spray method. The surface was coated with several layers of Pyro-Safe Flammoplat SP-A and finally protecting layer Decklack SP-1. The Thickness of the layer (560 /1260/1860 microm) was permanently measured. This means that for each turbine hall there are approximately 7000 measuring points including the corresponding documentation.

## 6. Lessons learnt

During the performance of coating work there were permanent sources of disturbance. For example, in irregular intervals. Unauthorized persons asking for approvals, certificates, licenses and other documents. These unauthorized persons were handled by ZNPP coordinator in this specific project.

His engagement was very effective and the contractor thanked the plant for his efficient support.

Notwithstanding, it is very important to remind all involved parties especially the design institutes that the primary responsibility for ensuring safe operation rests with the licence holder, that means with the utility. The regulatory authorities have a major role in being responsible for checking that operators comply with all the conditions set out in their operating licence.

It is absolutely necessary to have all licensing papers at the beginning of the work. These licensing papers should be transformed by an order of the General Manager of the plant into an internal mandatory decree (*ukaz*).

All documents necessary for the work should be available close to the working place (in situ).

The work at three shifts involved difficulties with the access of the foreign supervisor of the work from Brandschutz company. In similar situations, this problem should be resolved beforehand.



Fig. 3 Present view of the turbine hall - walls with fire resistant coating



Fig. 4 Turbine hall - on the left a column with fire resistant coating



Fig. 5 Support columns in the turbine hall coated with fire resistant layers.



Structures in the turbine hall with fire resistant coating



Structures in the turbine hall covered with fire resistant coating