

Experience of international projects implementation at Leningrad Nuclear Power Plant

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ABSTRACT

During the period of 1992-2007 more than 60 different projects of different specificity and budget have been successfully implemented in frames of Technical Assistance for the Commonwealth of Independent States (TACIS) Program, Project financed by European Bank for Reconstruction and Development (EBRD), as well as in frames of Agreements on Cooperation between Leningrad NPP and Radiation and Nuclear safety Authority of Finland (STUK) and Swedish Nuclear Power Inspectorate, International Co-operation Program SKI-ICP(SIP). All these projects were directed to the safety increasing of the Leningrad NPP reactor, type RBMK-1000.

Implementation of the technical aid projects has been performed by different foreign companies such as Aarsleff Oy, (Finland), SGN (France), Nukem (Germany), Jergo AB (Sweden), SABAROS (Switzerland), Westighthouse (USA), Nordion (Canada), Bruel&Kjer (Denmark), Data System & Solutions (UK), SVT Braundshuz (Germany) WICOTEC (Sweden), Studsvik (Sweden) and etc. which has enough technical and organizational experience in implementation of such projects, as well as all necessary certificates and licenses for works performance.

Selection of a Contractor/Supplier for a joined work performance has been carried out in accordance with the tender procedure, technical specification and a planned budget.

Project financing was covered by foreign Consolidated Funds and Authorities interested in increasing of Leningrad NPP safety, which have valid intergovernmental agreements with Russian Federation on the technical assistance to be provided to the NPPs. At present time all joined international projects implemented at Leningrad NPP are financed jointly with LNPP.

All projects can be divided into technical aid projects connected with development and turnkey implementation of systems and complexes and projects for supply of equipment which has no analogues in Russia but successfully used all over the world.

Positive experience of the joined projects implementation at Leningrad NPP allows concluding on precision of priorities at selection of aims and methods of technical tasks solution in co-operation with foreign colleagues.

INTRODUCTION

All international projects are implemented on Leningrad NPP in frames of annual programs between the Companies representing countries have concluded intergovernmental agreements with Russian Federation on the technical assistance to be provided.

For example the Radiation and Nuclear safety Authority of Finland (STUK) and Swedish Nuclear Power Inspectorate SKI-ICP (SIP) in co-operation with Leningrad NPP have realized more than 20 projects directed to the safety and reliability increasing of Leningrad NPP as a whole. Every year the most important projects to be implemented in the coming year within the limits of given budgets are discussed by Leningrad NPP from one side and STUK (Finland) or SKI-ICP (Sweden) from another side at regular joint meetings. Having assessed LNPP proposals the experts of the state authorities such as STUK or SKI-ICP issue a conclusion and agreement for a joint co-operation for a certain project and develop a detailed work performance schedule. One of the most important factors affecting the work completion in time with a satisfactory result for both parties is a well-grounded approach to selection the equipment Supplier and Installation Company.

The preferences are given to the companies of world reputation and great experience in implementation of such projects, as well as to those having advanced techniques and using state-of-the-art equipment and materials unparalleled in Russia.

Availability of the Quality Control System as well as experience in the field of technical projects implementation at other NPPs is also important while choosing the Supplier. As a rule, the preferences are given to Company offering the equipment or system delivery, installation and its further service in frames of the service contract. All necessary technical requirement and conditions are formed at the stage of preparation of the technical specification which will be inseparable part of the Contract later on.

INTERNATIONAL PROJECTS

During the period of this international co-operation more than 60 different projects have been successfully implemented. The below given table reflects successfully realized programs for the period of 2002 – 2005.

The list of international projects implemented within the period of 2002-2005.

Company/Organization (Contracting party)	Contract description	Contract №	Date of signing	Contract type
Brüel and Kjær (Denmark)	Vibration monitoring equipment for main rotating machinery and associated services	DNR 60343/B-2	14.11.97	technical aid
Westinghouse Industry Products International Co., Inc (USA)	Hydrogen monitoring system	DNR 60217/B-4.4	20.01.98	technical aid
SGN (France)	Liquid Radwaste solidification facility for Leningrad NPP	NSP-023-SPT-001	19.01.99	technical aid (TACIS)
SGN (France)	Spare parts, accessories and consumables for Liquid Radwaste solidification facility	NSP-023-SPT-001/95	19.01.99	technical aid
Danish Emergency Management Agency (DEMA) (Denmark)	Agreement for co-operation between Leningrad NPP and Denmark Ministry of Internal Affairs (DEMA)	№17-TA/208	18.04.00	technical aid
TOPSIL Semiconductor Materials A/S (Denmark)	Contract for reactor silicon treatment (radiation alloying)	1163	23.10.01	export
SABAROS S.A. (Switzerland)	Contract for supply of accessories to automatic welding equipment and associated services	684	23.12.01	technical aid
RWE NUKEM GmbH (Germany)	Supply of the facilities and systems for treatment and conditioning of Leningrad NPP solid Radwastes and associated services	LEN-02-02	17.01.02	import

Brüel and Kjær (Denmark)	COMPASS condition monitoring system support and service	02S3613-08/899	25.10.02	import
Fortum (Finland)	Supply of Electronic Document Management System (EDMS)	NSP-022-SPT-003/95	24.05.02	technical aid
JERGO AB (Sweden)	Supply of special equipment for pipelines mechanized cutting and edge preparation before welding	548	28.06.02	technical aid
MDS Nordion (Canada)	Contract for cobalt-60 supply	438a	01.08.02	export
STUK (Finland)	List of projects to be implemented in 2002. Amendment to LNPP-STUK co-operation agreement dated 11.04.00	Amendment №2	-	technical aid, joint financing
Canberra Industries Inc. (USA) and SSI (Sweden)	Contract for supply of TLD system, equipment installation and associated services.	750	14.11.02 Completed in 2004	joint financing:
PNNL (CIIA), Westron (Ukraine)	Contract for after guarantee service of the Safety Parameter Display System (SPDS)	412414-A-R8	27.01.03	technical aid
RKK Company (Russia) SIP (Sweden)	Supply of trunk-line radio communication system of the TETRA protocol	6.7 -95568	05.08.03 completed in 2005	joint financing: Concern REA – SIP
Aarsleff OY, STUK (Finland)	Service water system pipelines protection from corrosion, unit 1	681	22.09.03 completed in 2004	joint financing: Concern REA – STUK
DS&S (Great Britain)	Upgrading of Control Room Panels, Leningrad NPP	NSP-035-SPT-001/96	19.12.03	technical aid
PNNL (USA), Westron (Ukraine)	Contract for after guarantee service of the Safety Parameter Display System (SPDS)	412414-A-R8	Completed on 27.01.03	technical aid
svt Brandschutz (Germany)	Supply of the fire-prevention system for the pipes penetration protection	170	17.03.03	import
Brüel and Kjær (Denmark)	Contract for supply of equipment and associated serviced for LNPP Unit 1 “COMPASS” system	230	12.05.03	import

	upgrade			
WICOTEC (Denmark)	Contract for supply of the service water pumps and associated services	444	27.06.03	import
STUK (Finland)	List of projects to be implemented in 2003. Amendment to LNPP-STUK co-operation agreement dated 11.04.00	Amendment №3	20.11.02	technical aid joint financing
SIP (Sweden)	List of projects to be implemented in 2003. Amendment to LNPP-SIP co-operation Agreement dated 28.06.2001	-	-	technical aid
SABAROS S.A. (Switzerland)	Contract for supply of accessories to automatic welding equipment and associated services	701	16.11.04	technical aid
JERGO AB (Sweden)	Supply of special equipment for pipelines mechanized cutting and edge preparation before welding	702	19.11.04	technical aid
STUK (Finland)	List of projects to be implemented in 2004. Amendment to LNPP-STUK co-operation agreement dated 11.04.00	Amendment №4	20.11.03	technical aid joint financing
SIP (Sweden)	List of projects to be implemented in 2004. Amendment to LNPP-SIP co-operation Agreement dated 28.06.2001	-	26.01.04	technical aid
SKI (Sweden)	List of projects to be implemented in 2005. Amendment to LNPP-SIP co-operation Agreement dated 28.06.2001	-	13.10.04	technical aid, joint financing
STUK (Finland)	List of projects to be implemented in 2005. Amendment to LNPP-STUK co-operation agreement dated 11.04.00	Amendment №5		technical aid, joint financing
Studsvik (Sweden)	Delivery of equipment for Electro-Potential measurement and associated services	№6.2 -95742	15.11.05	100% technical aid, SKI-ICP (Sweden)
WICOTEC (Denmark)	Contract for supply of the service water pumps and	№555	05	import

	associated services for LNPP Unit 2			
GSE, CIAA	Simulator upgrade for Leningrad Nuclear Power Plant 1	№98-112/742100M		import
SKF, Sweden	Contract for supply of the service water pumps and associated services for LNPP Unit 2	№294		import
Brüel and Kjær (Denmark)	After-sales service of the vibration monitoring equipment for main rotating machinery	№ 02S3613-07/900		import
Flender Loher, (Germany)	Contract for the service water electrical motors spare parts delivery and associated services	№S01/06		import
SKI (Sweden)	List of projects to be implemented in 2006. Amendment to LNPP-SIP co-operation Agreement dated 28.06.2001	-		technical aid joint financing
STUK (Finland)	List of projects to be implemented in 2006. Amendment to LNPP-STUK co-operation agreement dated 11.04.00	Amendment №6		technical aid joint financing
«DOM-01», Moscow	Supply of the fire protective doors for the Leningrad NPP Unit 1 and installation services	№6.5 95754		technical aid, joint financing
STUK, Finland	Supply of equipment for Automatic personnel Access Control System (ASCOD) and spare parts for turnstiles	№6/772/06		technical aid, joint financing
Aarsleff OY (Finland), STUK (Finland)	Service water system pipelines protection from corrosion, unit 2	№725		technical aid, joint financing
Canberra NV/SA (Belgium)	Contract for supply of the gamma-spectrometer and gamma meters			technical aid, SKI-ICP (Sweden)
Opened Joint-Stock Company «Veza» (Russia)	Supply and installation of the fire dampeners for LNPP Units 1 & 2		December, 2007	technical aid, SKI-ICP (Sweden)

Aarsleff Oy (Finland)	Service water system pipelines protection from corrosion, unit 3 and M2		October, 2007	joint financing STUK
STUK (Finland)	List of projects to be implemented in 2007. Amendment to LNPP-STUK co-operation agreement dated 11.04.00	Amendment №7		technical aid joint financing
Habia Cable Nordic	Delivery of the heat-resistant cable			import
WICOTEC (Denmark)	Contract for supply of 4 service water pumps and associated services (Supplier - WICOTEC)			

A fruitful mutually beneficial co-operation with Radiation and Nuclear safety Authority of Finland (STUK) and Swedish Nuclear Power Inspectorate SKI-ICP (SIP) have been lasting for 16 years already.

**DATA ON INTERNATIONAL PROJECTS IMPLEMENTED
IN CO-OPERATION WITH SKI-ICP (SWEDEN)**

In-Depth Safety Assessment, Project LISA-C of Leningrad NPP

This Program of co-operation comprises the below listed projects directed to different aspects of the Safety Analysis:

1. Parametric analysis of failures due to common reason to be accounted in the probabilistic safety analysis models.
2. Assessment of the initial events frequency connected with the loss of coolant.
3. Operator reliability analysis.
4. The fault tree modeling for 1st and 2nd level of the defense in depth system.
5. Development of the Risk Watcher and solution concerning the monitoring application:
 - 5.1. Analysis of disfunction and precursor events affect.
 - 5.2. The process regulation statements analysis in the part of allowable down time for the safety important systems equipment during repair.
 - 5.3. Optimization of the safety important systems equipment check-outs intervals.
6. Development of probabilistic safety analysis (PSA) models in the part of internal impacts analysis.
7. Development of PSA models in the part of external impacts analysis.
8. Harmonization of PSA, deterministic safety analysis (DSA) and emergency instructions.
9. Analysis of the equipment aging trends.
10. Development and assessment of measures directed to the safety increasing.

As a result of this project modern technologies as well as risk-informative approaches to the safety analysis for practical application during operation were successfully implemented on the Leningrad NPP site. Technical manuals were developed for all above mentioned aspects where required; an order of pilot investigations was carried out with the help of these manuals. A full-scale 1st level PSA model for Unit 1 was upgraded, as it is a basis for the Risk Watcher. The risk monitor within the bundled software environment Risk Watcher – is currently under development (the software company, Relcon AB, provided LNPP with a licensed copy of this software).

Delivery of special equipment for pipelines mechanized cutting and edge preparation before welding during the period of primary circuit repair and reconstruction and associated services (2 sets). (Contract № 548 dated 08.06.02)

Equipment for 325mm pipelines mechanized edge preparation was delivered to LNPP. This project allowed providing a separating cutting of the pipelines Dy325 mm with wall thickness of 16mm made of austenitic steel 08X18H10T with subsequent edge preparation for welding.

Delivery of automatic welding equipment and associated services (automatic microprocessor-controlled pipe-to-pipe welding equipment). (Contracts №1507 dated 15.01.02 & № 684 dated 03.09.03)

Equipment delivered in the frames of this project allowed performing an automatic welding of nonrotatable junction of the pipelines Dy325 mm with wall thickness of 16mm made of austenitic steel 08X18H10T.

Supply of trunk-line radio communication system of the TETRA protocol in order to provide the nuclear facilities safe operation at emergency situations (Contract №6.7-95568 dated 05.08.03)

In frames of this project a new promising trunk-line radio communication system based on the opened digital standard TETRA, which is to the fullest extent not inconsistent with emergence communication requirements. Implementation of the trunk-line radio communication system at Leningrad NPP has allowed to increase essentially the nuclear facilities operational safety and emergency preparedness, as well as to provide the emergency prevention activities control within the area of 30 km.

Supply of the fire protective doors for the Leningrad NPP Unit 1 and installation services (Contract №6.5 95745 dated 21.11.2005).

In the course of LNPP fire safety improving measure implementation all 63 doors have been delivered and installed in expanded corridors and stairwells of building 401 (Unit 1). Acceptance Tests of 63 fire protective doors have been successfully performed.

INTERNATIONAL PROJECT
“SERVICE WATER SYSTEM PIPELINES PROTECTION FROM CORROSION, UNIT 2”

The Contract for supply and installation of anticorrosion protection of the service water system pipelines of LNPP Unit 2 and associated services has been realized in frames of bilateral co-operation between Leningrad NPP and STUK (Finland) in 2006, (Contract № 725 dated 25.07.2005).

Aim of the project – the service cooling water pipeline repair of Leningrad NPP Unit 2.

The pipeline to be protected is subjected for cooling sea water supply to the process condensers and the heat exchangers of Unit 2 main and auxiliary equipment.

Cooling sea water supply pipeline requiring protection from corrosion has been laid under ground and connects the pumphouse located in building 410 with consumers in building 401.

The pipeline internal diameter is 1200 mm, its length ~ 192 m, including two sections of ~ 40 and ~ 6 meters length with internal diameter of 1400 mm.

The pipeline repair has been carried out with application of so-called flexible polyester resin (SOCK) that withstands thermal expansion. The thermal expansion occurs in the pipeline due to the sea water temperature changing. Minimal pressure value that the existing steel pipeline covered with anticorrosion coating must withstand is 6 Bar. Nominal wall thickness of pipe-sock is 18mm.

The sock material is well resistant to the sea water chemical composition.



Figure 1 Anticorrosion coating before installation into the pipeline

Following the Contract requirements Leningrad NPP has performed the pipeline preparation for the SOCK.



Figure 2 The pipeline before refinement from corrosion and sediment products



Figure 3 The pipeline after refinement and installation of the anticorrosion coating

The SOCK lead-in to the pipelines has been performed with the help of water supplied from a special tower. The SOCK feeding to the tower has been carried out by means of the conveyer installed on the edge of the camera; the feeding speed has been controlled depending on water pressure and volume.



Figure 4 The facility general view



Figure 5 The facility general view

Upon the pipelines sanitation completion the Closed Joint-Stock Company "Per Aarsleff SPb." has performed lamination on the pipelines end sections, which comprises coating the pipeline-sock

joint with a special protective layer of glass fiber and epoxy resin. Before this procedure the pipeline was subjected for primary refining from rust up to metallic luster by LNPP specialists. The lamination allowed avoiding completely the leakages between the hardened sock and existing pipeline.



Figure 6 Laminated section 1



Figure 7 Laminated section 2

In June 2006 in frames of international project “Aarsleff” Company (Finland) has supplied and installed anticorrosion coating onto the internal surface of the underground section service water system pipelines of LNPP Unit 2 (SWS-2).

The SWS-2 pipeline with installed anticorrosion protection has been successfully accepted and handed over for exploitation after 72 hours operation at working pressure without comments.

Installation of the anticorrosion protection into the sea service water pipelines (SW-3) has been carried out during the period of 2007 – 2008.



Figure 8 Anticorrosion coating

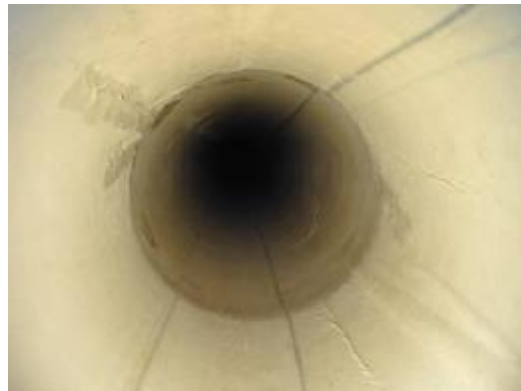


Figure 9 Anticorrosion coating

INTERNATIONAL PROJECT
“SUPPLY OF THE FIRE PROTECTIVE DOORS FOR THE LENINGRAD NPP UNIT 1 AND
INSTALLATION SERVICES”

In 2006 in frames of Contract № 6.5 95745 the first stage of the fire protective doors installation in the corridors and stairwells for the Leningrad NPP Unit 1, building 401, has been completed.

Acceptance test of the first batch of doors (50 pcs.) have been carried out In accordance with the “Fire protective Doors Acceptance Tests Program” on 18.10.2006.

Acceptance tests have been carried out by commission including representatives from Leningrad NPP, SKI ICP (Sweden), Open Joint-Stock Company NPO “DOM-01” (Russia).

Full volume acceptance tests have been performed on 8 installed fire protective doors with full scope of equipment. The following doors were tested: 5 double-wing doors having the fire-resistance limit - EI60 (3 of them have an observation window) and 3 single-leaved doors fire-resistance limit - EI 60.



Figure 10 Single-leafed fire protective door



Figure 11 Double-wing fire protective door

In the course of the acceptance tests the manufacturing and installation quality inspection of the fire doors supplied by Open Joint-Stock Company NPO "DOM-01" (Moscow) has been carried out.

In the course of these tests the acceptance commission didn't reveal any serious comments with relation to the fire doors installation quality and confirmed that all these all 50 doors conformed the requirements specified by the Contract.

Installation and acceptance tests of the remaining 13 fire doors in building 401 have been performed during the period of Unit 1 planned outage for maintenance in June - July 2007.

CONCLUSION

Nuclear technologies are widely used in a peaceful nuclear power industry all over the world. Any negative effects of the nuclear power industry on the surrounded medium will be immediately identified by out close neighbour states. The condition impels neighboring states to co-operate with each other for the purpose of safety improving at the nuclear power industry objects, such as Nuclear Power Plants. In view of international politics and co-operation it would be a great mistake to leave possible risks connected with nuclear power energy without an appropriate attention. That is why the states such as Finland, Sweden, Norway, Denmark and many other ones take an active part in co-operation with Russia in the field of nuclear and radiation safety improving in order to provide a high level safety for all states of the Baltic Region.

A joint work between Russia and states of the Baltic Region is based on projects implementation with application of both a state-of-art scientific and technological potential and safety standards of high level. Owing to a joint fruitful and mutually beneficial co-operation we have realized many different technical projects directed to improving of Leningrad NPP safety and reliability, as well as maintaining a high level stability of the nuclear and radiation safety in the region as a whole.