

**Chernobyl NPP: Completion of LRW Treatment Plant
and LRW Management on Site - 12568**

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ABSTRACT

Since a beginning of ChNPP operation, and after a tragedy in 1986, a few thousands m³ of LRW have been collected in a storage tanks. In 2004 ChNPP started the new project on creation of LRW treatment plant (LRWTP) financed from EBRD fund. But it was stopped in 2008 because of financial and contract problems. In 2010 SIA RADON jointly with Ukrainian partners has won a tender on completion of LRWTP, in particular I&C system. The purpose of LRTP is to process liquid radwastes from SSE "Chernobyl NPP" site and those liquids stored in the LRWS and SLRWS tanks as well as the would-be wastes after ChNPP Power Units 1, 2 and 3 decommissioning. The LRTP design lifetime - 20 years.

INTRODUCTION

Construction of LRTP is financed from Nuclear Safety Account of European Bank for Reconstruction and Development (EBRD) and contribution of Ukraine. LRTP is designed for treatment of liquid radioactive waste accumulated during operation and those generated during ChNPP decommissioning, and operational LRW of Shelter Object. LRTP is also designed for LRW treatment during 10 years of operation. Its minimal designed capacity is 2,500 m³ of non-treated LRW per year.



Fig. 1 .Liquid Radioactive Waste Treatment Plant (LRTP)

LRTP consists of:

- Facility for liquid radioactive waste (LRW) removal from existing storage facilities;
- Facility for LRW transportation to treatment facility;
- Facility for treatment and cementation of LRW with purpose of containment and immobilization.

Work progress

Currently, the Liquid Radioactive Waste Treatment Plant (LRTP) is in a status of “incomplete construction”. SSE ChNPP is performing the maintenance of systems that ensure activity of the facility.

Pursuant to the decision concerning the further financing of the LRTP completion that was taken on July 2007 at the Assembly of Nuclear Safety Account donor countries, the SSE ChNPP jointly with Improving Safety PMU are performing activities on preparation and carrying out of tender procedures in accordance with the EBRD Procurement Policies and Rules.

According to LRTP General Plan all the activities required for the project completion are divided into work packages as follows:

Package “A” – engineering and design activities on LRTP

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In the frameworks of concluded Contract between SSE ChNPP and Kiev Institute “Energoproekt” (KIEP) for consulting services the following tasks are carrying out:

Task A-3 - Development of work documentation on certain modifications of LRTP.

Package “B” – procurement, supply, installation, pre-commissioning activities and commissioning

Task “B1 – B6” – Completion of supply, installation activities and LRTP facility commissioning.

Task “B7” – procurement of mass-spectrometer

Task “B8” – Completion of activities on Reloading System (LRTP RLS)

Task “B9” – completion of activities on Radiation Monitoring System (RMS)

Package “C” – Completion of supplies, installation, and commissioning of LRTP Automated Process Control System (APCS)

Package “D” – expert and consulting service

Package “D-1” – Laboratory – methods and procedures,

Package “D-2” – Development of end product’s composition.

METHOD OF LRW TREATMENT

The Package C now remains the most of important Task to be solved as a system operated all the processes at the LRTP.

The system includes the following processes:

1. Chemical Process:
 - Receiving of LRW in LRTP reception tanks;
 - LRW processing;
 - LRW Cementation;
 - Treatment of process water.
2. Auxiliary - this will comprise of an Auxiliary System workstation and a Technical Process PLC with sensors and actuators.

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3. Handling of LRW - this will comprise of a Container Handling and Radiation Monitoring:
 - container transfer (drums and overpacks) on the process chain;
 - opening\closing of the protection doors;
 - hardness check;
 - lids crimp.
4. Container Radiation Monitoring - this will comprise of a Container Handling and Radiation Monitoring workstation and a Container Radiation Monitoring PLC with sensors and actuators.
5. Tracking - this will comprise of a Tracking workstation, a Drum Receipt workstation, a Chemical Laboratory workstation, a Curing Room workstation, an Overpack Filling workstation with sensors and actuators:
6. Tracking at the LRTP site;
7. Tracking outside the site by means of sending data on overpacks leaving the Treatment Plant to the corresponding entities (via data system integration),
8. Batch control during preliminary treatment, including control of tanks in which preliminary treatment is carried out; samples are analysed in the laboratory,
9. Control of 200 l drums over the whole plant area,
10. Overpacks control,
11. Content control of supernatants, low and middle active flows.
12. Ventilation - this will comprise of a Ventilation workstation and Ventilation PLC with sensors and actuators.

The "LRTP Process diagram" presented at Figure 1 herein is the baseline for CPCS implementation activities.

LRW currently stored in five 5000 m³ tanks which are as follows:

- A-201/2, A-201/3 - evaporator concentrate.
- A-202 - spent ion exchange resins.
- A-203/1, A-203/3 - spent perlite pulp.

Also LRW currently stored in nine 1000 m³ tanks which are as follows:

- X-01/1, X-01/2, X-01/3, X-01/4, X-01/5 - evaporator concentrate.

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- X-05/1, X-05/2 - spent ion exchange resins.
- X-06/1, X-06/2 - spent perlite pulp.

Tanks at SSE ChNPP industrial site:

- 5000 m³ at Liquid Radwaste Storage Facility (LWS, Building 83);
- 1000 m³ Solid and Liquid Radwaste Storage Facility (SLWS, Building 84).

In accordance with "Main Sanitary Regulations for Radiation Safety of Ukraine" (DSP 6.177-2005-09-02), following the result of 2006 survey, wastes of LWS and SLWS tanks are the LRW of "low and middle activity".

Cs137 makes the main contribution to the activity. All alpha-emitting radio-nuclides contribute 0.01-0.03% of total activity.

There are three main types of wastes that are to be retrieved, processed and subsequently conditioned. As of 1st January 2010 the volume of these wastes is as follows:

- evaporator concentrate - 13,296.50 m³;
- perlite pulp - 2,262.12 m³;
- ion exchange resins - 4,055.20 m³.

RESULTS AND DISCUSSION

After the Technical Design approval, the working Documentation has been developed.

The system realized is presented at Fig. 2. The Tables 1 and 2 here below show the characteristics of LRW and solid phase stored at ChNPP.

Since the date of contract awarding the huge scope of work has been performed:

- the collection of the data,
- systematizing of the information received,
- the plan of work is developed and approved by ChNPP,
- the conceptual design of I&C system is developed,
- the technical design is developed and approved,
- the detailed design is developed and approved,
- the expertise of design is conducted including the metrological one,
- the scope of equipment to be supplied is prepared, and equipment is purchased.

As a result the installation works have been started and preliminary operation tests of separated systems have been conducted. There were different approaches for the technology improvements have been performed.

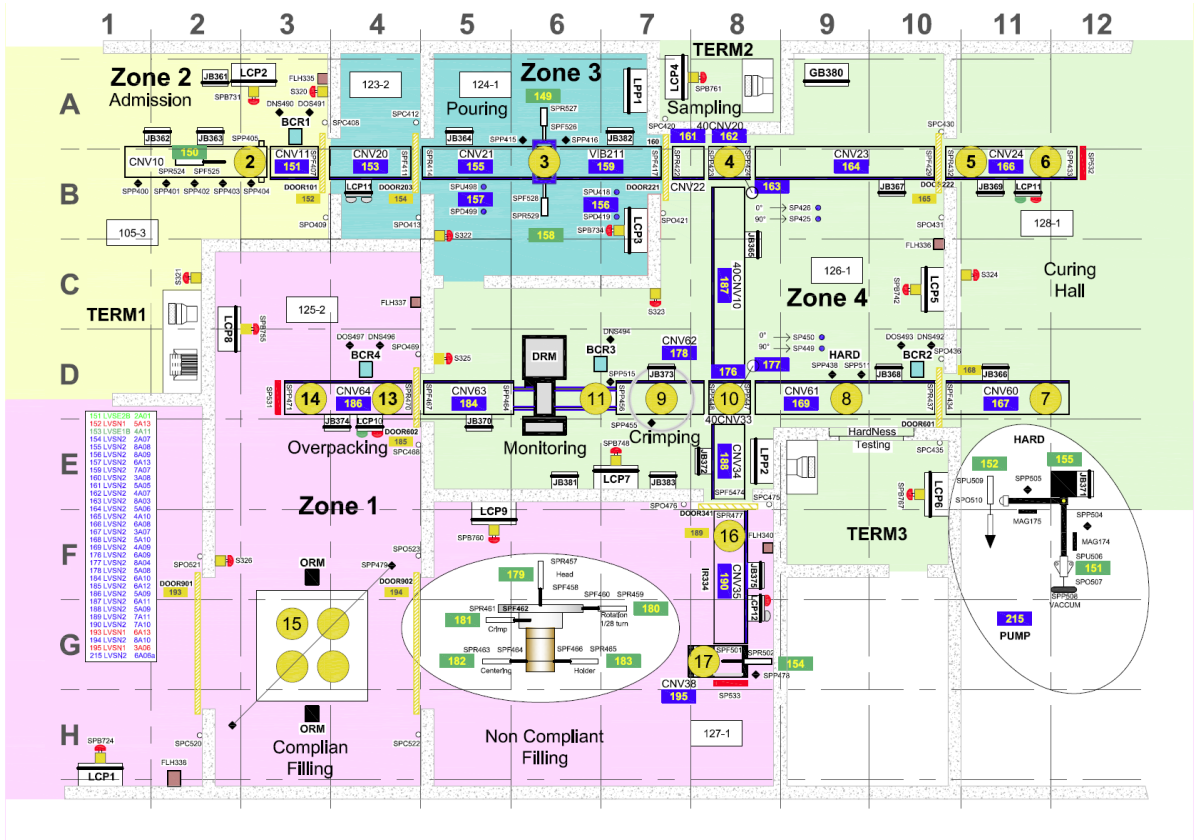


Fig 2. L RTP Process diagram



Fig 3. LRW Processing System

Table I. LRW Characteristics

| Tank # | Content | Total Activity (Ci/l) | Mn-54 (Ci/l) | Co-58 (Ci/l) | Co-60 (Ci/l) | Cs-134 (Ci/l) | Cs-137 (Ci/l) | Sr-90 (Ci/l) | α (Ci/l) |
|---------|----------------------|-----------------------|--------------|--------------|--------------|---------------|---------------|--------------|-----------------|
| A 201/2 | Decantate | 4,70E-04 | | | 1,90E-07 | 3,00E-06 | 4,70E-04 | 5.2E-09 | 1,70E-10 |
| A 202 | Spent Ion-Exchangers | 7,60E-06 | | | 9.20E-07 | 3,90E-07 | 6,30E-06 | 1.4E-07 | 6,00E-11 |
| A 203/1 | Perlit | 2,50E-06 | | | 1,10E-08 | 7,40E-08 | 2,50E-06 | 4.2E-08 | 2,10E-10 |

Table II. Solid Phase Characteristics

| Tank # | Content | Total Activity (Ci/l) | Mn-54 (Ci/l) | Co-58 (Ci/l) | Co-60 (Ci/l) | Cs-134 (Ci/l) | Cs-137 (Ci/l) | Sr-90 (Ci/l) |
|---------|----------------------|-----------------------|--------------|--------------|--------------|---------------|---------------|--------------|
| A 201/2 | Decantate | | 2,63E-05 | 1,58E-04 | 1,71E-05 | 2,91E-03 | 3.8E-05 | 3,00E-08 |
| A 201/3 | Spent Ion-Exchangers | | | | | | 3E-05 | 1,20E-08 |
| A 203/1 | Perlit | 3,0-7,0E- | | | | | 1E-05 | 1,10E-07 |

CONCLUSION

Currently, the LRTP is getting ready to perform the following activities:

1. retrieval of waste from tanks stored at ChNPP LWS using waste retrieval system with existing equipment involved;
2. transfer of retrieved waste into LRTP reception tanks with partial use of existing transfer pipelines;
3. laboratory chemical and radiochemical analysis of reception tanks content to define the full spectrum of characteristics before processing, to acknowledge the necessity of preliminary processing and to select end product recipe;
4. preliminary processing of the waste to meet the requirements for further stages of the process;
5. shrinkage (concentrating) of preliminary processed waste;
6. solidification of preliminary processed waste with concrete to make a solid-state (end product) and load of concrete compound into 200-l drums;
7. curing of end product drums in LRTP curing hall;

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8. radiologic monitoring of end product drums and their loading into special overpacks;
9. overpack radiological monitoring;
10. send for disposal (ICSRM Lot 3);

The current technical decisions allow to control and return to ChNPP of process media and supporting systems outputs until they satisfy the following quality norms: salt content: < 100 g/l; pH: 1 - 11; anionic surface-active agent: < 25mg/l; oil dissipated in the liquid: < 2 mg/l; overall gamma-activity: < $3,7 \times 10^5$ Bq/l.

REFERENCES

1. Chernobyl Nuclear Power Plant. Decommissioning projects: Liquid Radwaste Treatment Plant, April 2010, <http://www.chnpp.gov.ua>.