

Support in licensing activities related to decommissioning of Chernobyl NPP

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SUMMARY

Since 1995, IPSN and GRS have been working under Riskaudit contracts in the framework of the TACIS programme to support the Nuclear Regulatory Administration of Ukraine (SNRA) for the licensing activity related to the different tasks to be performed in order to implement an acceptable solution to the present situation.

In addition to the «shelter» programme, the European Commission asked Western Technical Safety Organisations (TSO) to assist the SNRA for the licensing activity related to the decommissioning of the Chernobyl NPP units 1, 2 and 3.

This last project is underway. A specific organisation has been set up by Riskaudit grouping also Belgian (AVN) and Italian (ANPA) partners to collaborate with the SNRA technical support (SSTC) all along the licensing steps of five facilities dedicated to treatment, storage or disposal of burnt fuels and radioactive effluent and waste. It succeeds to a previous project aimed at elaborating the new Ukrainian regulatory documents on the principles of safety assessments based on aims/objectives and on a certain freedom in choosing the way of achievement of those aims.

INTRODUCTION

In 1986, an accident occurred on unit 4 of the Chernobyl NPP leading to a release of radioactive nuclides, which had dramatic consequences mainly for the workers at the site and the population of Belarus, Ukraine and Russia. Following the accident, within a few months, a shelter structure was erected on the ruins of the building.

An industrial expert team, organised by the European Commission (EC) in 1995, presented a set of tasks to consolidate this structure which does not exhibit the required reliability and maintenance criteria. These tasks, proposed by the industrial expert team in the «Shelter Implementation Plan» (SIP), were agreed upon in mid-1997 by the Ukrainian government and the G7 member states.

In parallel, a plan for shutdown and decommissioning of the three other reactors of the site has been developed with the support of the international community through the European Bank for Reconstruction and Development (EBRD) and the TACIS programme. This plan, which includes the implementation of spent fuel storage and liquid waste treatment facility for pre-decommissioning activities, is completed with installations for solid waste management.

The objective is to process the existing wastes produced during the plant operation and wastes which are going to be produced up to the shutdown of units 1, 2 and 3. Management of wastes from Unit 4 is excluded from this project.

Processing of wastes produced through the shutdown of all the units of Chernobyl NPP cannot be however currently planned since general strategy for the whole decommissioning period and waste management has not been yet clearly agreed upon between the government of Ukraine and the operator of the plant. It is a major concern for the coming years and revision of the objectives of some of the planned facilities cannot be excluded when that strategy is finally set up.

STATUS OF THE NORMATIVE DOCUMENTATION FOR LICENSING

A work plan was established, at the request of the European Commission, in the framework of a TACIS contract, dealing with the following topics :

- developing requirements and regulations to be applied to the decommissioning process and to the waste management on the basis of internationally accepted principles and procedures,
- defining safety objectives to be notified to the operators, assessing the strategy, programme and measures proposed by the operators respectively for the decommissioning of the Chernobyl units 1, 2 and 3, and the management of the wastes resulting from decommissioning work,
- drawing up the inspection activities to ensure compliance with safety requirements.

The corresponding two-year project, started in January 1997, involved in a close collaboration the TSOs and the Nuclear Regulatory Authority of Ukraine (SNRA). Each task was elaborated within the same scheme :

- presentation of technical guidelines related to the task by the TSOs to the beneficiary (SNRA) and its technical support (SSTC),
- drawing up of regulatory or normative documents by the Ukrainian partners,
- assessment of the Ukrainian documents by the TSOs,
- presentation of the assessments during technical meetings,
- update of the documents and reassessment before approval by the concerned ministry.

Collaboration between TSOs and SNRA/SSTC lead to write up documents related to the following subjects :

- Ukrainian regulatory text on « General provisions on safety assurance of decommissioning of nuclear power plants and research reactors »,
- licensing procedure for decommissioning and decommissioning strategy,
- preparation for the decommissioning of a facility during its life cycle,
- normative documents on waste management.

These documents are very similar to those developed in western countries for the same goals and are in accordance with internationally accepted principles. Concerning waste management, some points still needed however to be developed at the end of the contract. In particular, waste classification had to be clearly defined as well as quality assurance and responsibilities of both waste producer and waste manager. These issues are of utmost importance when developing the corresponding licensing procedures.

OBJECTIVES OF THE PRESENT CONTRACT

All the following information related to the organisation set up to fulfil the terms of the contract and to the working procedures are detailed in a project manual.

This project manual has been sent to the European Commission after approval of the SNRA on May 21st, 1999.

Brief presentation of the contract

The present contract has been signed on January 7th, 1999 between the European Commission and Riskaudit (an EEIG created by IPSN and GRS aiming amongst others to participate to the development of safety culture in Eastern Europe countries) as a part of the

comprehensive programme for the Chernobyl NPP closure. This contract is aimed at providing the Ukrainian State Nuclear Regulatory Authority (SNRA) with an effective technical assistance for the licensing activity related to the EC and EBRD financed decommissioning facilities within the process of decommissioning of Chernobyl NPP units 1, 2 and 3.

Since the expected duration of the industrial projects is more than two years, it is planned that this whole licensing assistance programme to SNRA should be contracted in two phases.

The present contract, signed for a 26 month period, corresponds approximately to the phase covering the end of the assessment of the Preliminary Safety Reports of the different facilities.

It is divided into work packages related to the successive stages of the licensing process for each of the five facilities. Each work package is described in a work order and submitted to the European Commission. Work orders contain a list of tasks, schedules of these tasks and associated meetings, manpower involved and a detailed financial proposal. They have to be agreed upon by the EC before launching the technical work.

Main goals of the contract

The scope of the contract consists in supporting SNRA for its licensing activities related to the following facilities :

- the Spent Fuel Interim Storage Facility (SFISF),
- the Liquid Radwaste Treatment Facility (LRTP),
- the Low and Intermediate Level solid Waste Retrieval Facility (LILWRF),
- the Low and Intermediate level Solid Waste Processing Facility (LILWPF),
- the Low and Intermediate Level Waste (Short lived) engineered near Surface disposal Facility (LILWSF).

The main goals of the contract can be expressed as follows :

- developing the licensing process for all the facilities and, as far as necessary, requirements and associated regulations. In particular, the licensing steps have to be identified and the corresponding documents to be provided by the operator have to be defined,
- carrying out the assessments of analysis and requirements for the technical safety substantiation along the licensing steps.

Moreover, these actions have to be performed in a way enabling transfer of methodologies and practices for assessment of nuclear and radiological hazard at all the steps of the licensing process.

Western organisation

The leading company and contractor with the European Commission is Riskaudit. The Project Manager and the Administrative Project Manager belong to this company. To provide a team with complementary skills and experience, Riskaudit has built a consortium with IPSN, GRS, ANPA and AVN.

The counterpart and beneficiary is the Department for Radiation Technologies and Radioactive Waste of SNRA, technically supported by SSTC which is, in this contract, a Riskaudit subcontractor.

The different technical tasks of the project are distributed between the members of the consortium. A Technical Project Leader (TPL) belonging to one of the Western companies is nominated for each project. Each TPL is responsible for the project he is in charge of and he co-ordinates the work of the experts involved in the various relevant fields of activities of his project.

Two General Technical Project Leaders (GTPL), belonging respectively to IPSN and GRS, have been nominated to ensure the technical consistency of all the projects. They are responsible for all technical key decisions and results as well as for providing guidance for transversal activities and interfaces between the projects.

Those GTPLs make, with the Riskaudit Project Manager and the Administrative Project Manager, the Secretariat in charge of monitoring the different activities from a contractual point of view.

The Technical Management Group (TMG), composed of TPLs and GTPLs, meets at appropriate dates under the responsibility of GTPLs. This group is in charge of supporting the Technical Project leaders to solve their interfacing problems and appears as a consultative body for discussion of the main technical matters concerning several projects.

Relationship between TSO and SSTC

On its own, SSTC has built an organisational structure on the model of the Western structure with a General Project Leader and Project Leaders for each of the projects.

It has been decided that the assessment of the licensing documents (Safety Reports, Environmental Impact Assessments..) would be carried out by both organisations (Western TSOs and SSTC) in parallel. The recommendations will be compared at the end of each stage of the work and a final statement will be established after discussions between both parts and, if necessary, completion of additional work in order to deliver a set of common recommendations to SNRA. This type of approach has been chosen for the following reasons :

- it avoids a waste of time consecutive to a sequential work (assessment by SSTC followed by TSO evaluation) and,
- it allows mutual enrichment from both parts while comparing the evaluation methods implemented and the recommendations formulated at the end of each stage.

Working procedures with the industrial side

The industrial side is composed of the operator of Chernobyl NPP and its associated Project Management Units (PMU and OSAT) in charge of the follow-up of the different projects.

The licensing procedure indicates that each official document has to be submitted to the SNRA by the operator. The SNRA asks Riskaudit to assess these documents and receives recommendations before taking a decision. But Riskaudit representatives can nevertheless have direct contacts through meetings, letters or phone calls with the industrial side during preliminary discussions prior to the delivery of documents to the SNRA or during the assessment phases in order to get additional explanations.

This procedure makes the working procedures flexible and suitable with the tight schedules of the different projects.

Moreover, it appears that such a relationship, which is commonly implemented in the western countries, is the most efficient way to avoid severe misunderstandings between the industrial and the safety-related organisations.

SHORT DESCRIPTION OF THE PLANNED FACILITIES

The different facilities to be built are each in relation with the first phase of the Chernobyl NPP decommissioning strategy.

Spent Fuel Interim Storage Facility (SFISF)

Fuel assemblies on the site need to be stored in a dedicated building to allow them to cool down and the fission products to decay under adequate containment. When the Chernobyl NPP is closed, fuel assemblies will mainly be located in the RBMK reactor cores, in the reactor cooling ponds of the three units and in the existing KHOJAT-1 fuel storage pond. The limited remaining capacity and design life of that last storage facility requires a new storage building to be built.

This new facility, whose main features have already been defined, will be divided into two parts : the first one to prepare and condition the fuel assemblies, the second one to store them.

Using the transfer flasks already present on the site, the fuel assemblies will be transported from their intermediate storage areas to a hot cell, where the upper and lower fuel bundles will be separated by dry-cutting. The fuel bundles will immediately be placed into cartridges, while the extension rods will be cut and prepared before transfer to the plant storage facility. Absorber rods will be placed into cartridges and stored in a special vault located next to the processing facility.

The cartridges will be welded shut, filled with argon gas, then placed in the storage canisters. The inner space of the canisters will be filled with inert gas and closure lids sealed by automated welding. Canisters will then be transported to the dry storage vaults.

The required production rate will be 2500 fuel assemblies per year. It should allow to process all the spent fuel bundles and absorber rods over a ten year period. These fuel bundles will be placed in 256 storage casks, each stored in individual vaults.

Liquid Radwaste Treatment Facility (LRTP)

The liquid radioactive wastes are currently stored in 5000 m³ and 1000 m³ tanks respectively placed in two different buildings on the Chernobyl NPP site. The major part of the wastes stored in these tanks is composed of low level and intermediate level liquid wastes.

The treatment of the intermediate activity wastes contained in five 5000 m³ and nine 1000 m³ tanks will require retrieval, transfer and processing in a dedicated treatment facility. A few of these waste tanks contain also resins, pulps and sludges which could bring some complexity to the transfer and treatment operations.

The low level liquid wastes in the remaining tanks will be processed by the existing Chernobyl NPP evaporation facility.

Moreover, this treatment facility should ultimately process the decontamination effluents from Chernobyl NPP decommissioning. The amount of liquid wastes generated by these operations has not yet been precisely estimated.

The two sets of storage tanks are connected by a transfer pipework which runs in a transfer gallery. Transfer of the wastes from the tanks to the treatment facility will require installation of retrieval systems and specific connections between the retrieval equipment and the pipework to move them from the tanks into the transfer gallery and between the pipework and the treatment facility. The retrieval system will be composed of agitation devices and pumping systems.

After receipt in the LRTP, the volume of the wastes will, where possible, be reduced prior to the treatment process. Particular wastes such as spent resin and perlite pulp will have to be processed too in this facility. The final process in the LRTP prior to the packaging of the product will be a cementation process in order to immobilise the treated wastes in a matrix.

The final conditioning of these packages will depend on the acceptance criteria on the near surface disposal centre. So, it will probably be necessary to build intermediate buffer storage areas in order to receive these packages before a final solution is reached for disposal of every type of packages.

Low and Intermediate Level solid Waste Retrieval Facility (LILWRF)

Low and intermediate level solid wastes are currently stored on the Chernobyl NPP site in an above ground concrete shielded structure, separated into three compartments categorised according to the types of wastes. Their volumes are respectively 1087 m³, 1000 m³ and 1884 m³. The two first compartments are 98% and 92% full respectively and the third one, which is reserved for higher level solid wastes, is 18% full. Access to the compartments can be carried out via hatches of various sizes. The solid wastes are composed of « technological wastes » and are in the form of metal, concrete, plastics, wood, paper... The content of two of these compartments has been covered with a layer of concrete approximately 1 m thick.

Options for retrieval of the wastes include a mechanical grabber and an overhead crane retrieving waste from above, or using a digger and penetrating equipment to retrieve wastes through the side of the tanks. The retrieval equipment should be capable of breaking and retrieving the concrete cap that has been placed over the top of the stored active wastes and it should be designed to be movable, so that it can be used to retrieve successively wastes from the three compartments.

Wastes will be put in containers and transported to a sorting and conditioning facility. The retrieval rate should be about 3 m³ per day.

It is to be noted that wastes stored in the three compartments are not suitably identified and thus presence of high active wastes or fissile material will have to be envisaged during the retrieval.

Low and Intermediate Level solid Waste Processing Facility (LILWPF)

The LILWPF will be designed in a first step to process the wastes issuing from the retrieval facility. It could be adapted to the treatment of wastes from decommissioning of Chernobyl NPP reactors.

The facility will be also equipped with an incinerator aimed at burning contaminated oil coming from the turbines of the reactor units (about 300 m³).

The solid wastes from the retrieval facility will be transferred to a sorting bay in the LILWPF, where they will be sorted out and categorised in three types :

- compactable wastes for compaction,
- non-compactable wastes for packaging and grouting,
- wastes for interim storage ;

Compacted wastes and non-compactable wastes will be overpacked into containers approved for final disposal in an engineered near surface facility. Wastes will be grouted into these containers using a facility whose production rate should be approximately 10 m³ grout per day, allowing typically 20 m³ of packaged wastes to be grouted.

Some of the wastes retrieved from the solid waste compartments may be too large and bulky to be dispatched directly to an appropriate treatment process. They will require size reduction before compaction or direct packaging.

A part of the retrieved wastes will not be suitable for near surface disposal due to radiological and, maybe, chemical contents. Therefore, it will be placed into dedicated containers and sealed. These containers will be designed for long-term storage.

It is to be noted that categorisation of wastes has not been definitively set up by the Ukrainian government. This could be a major problem to design the waste processing facility and the subsequent near surface disposal area.

Low and Intermediate Level Waste engineered near Surface disposal Facility (LILWSF)

The LILWSF will receive packages containing LILW immobilised in a cement matrix, for final disposal. The packages will be of an approved design, meeting acceptance criteria set up by the disposal facility. All their characteristics will be recorded and filed when arriving on the site.

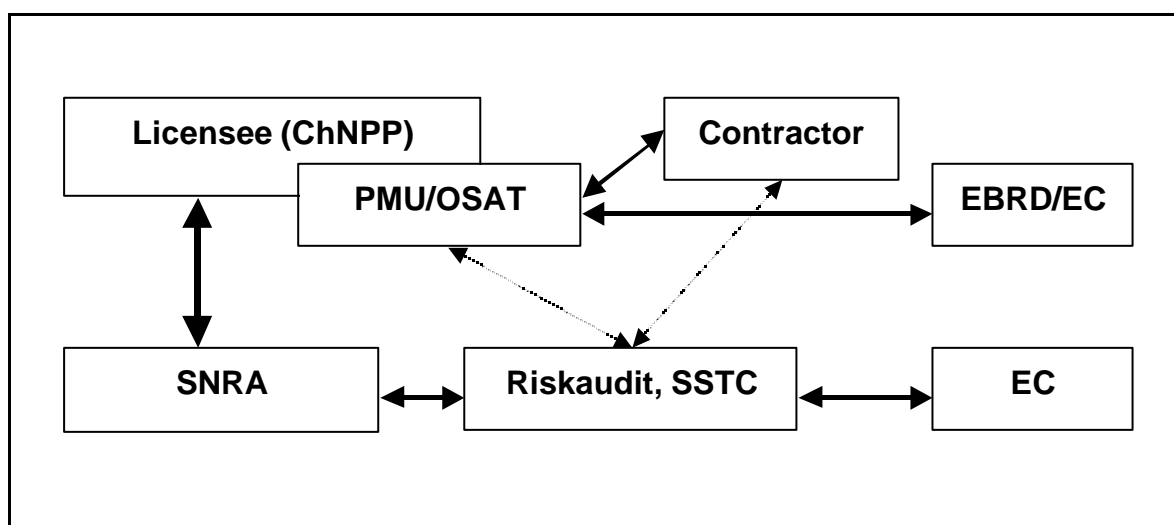
The design of this disposal will be based on an engineered near surface trench concept. The first phase of the construction will consist of one trench. The following ones will be built according to the waste packages production. Each of them will be capped as it become filled. Capping material will be selected so that it will assist in evacuating rainwater towards a surrounding drainage system.

This near surface disposal will be built in the Chernobyl restricted area. Its design is however currently delayed due to the lack of waste acceptance criteria for near surface disposal.

STATUS OF THE LICENSING PROCESS OF THE FACILITIES

Description of Project Management Units (PMU and OSAT)

The Project Management Units (Westinghouse PMU for facilities A and B and OSAT (On Site Assistant Team) for facilities C, D and E) are working on behalf of the EBRD (financing facilities A and B) and the EC (financing the facilities D to E). Their main task is to control the performance of the work by the contractors and to provide all the documents necessary for the licensing procedure from the contractors through the licensee (Energoatom/ChNPP) to the licensing authority (SNRA for nuclear and radiological safety aspects and other state organisations). The PMU consists of members of the ChNPP and of the Western consortium. For the SNRA, the PMU must be part of the licensee organisation (ChNPP) and this has to be clearly stated in the ChNPP QA manual. The links between the licensee, PMU, SNRA, etc are shown in the following chart.



Licensing steps to be performed

For each of the five projects, the licensing steps described in the Ukrainian regulatory documentation are bound to the main industrial steps from siting to operation of the facilities at full capacity.

These different steps are exhibited in the Table 1 with the list of associated relevant documents to be provided by the licensee.

These documents, submitted to the SNRA, have for most of them to be evaluated by the technical organisations acting as the SNRA support.

This list includes a document entitled « reconciliation document ». This document is specific to the concerned project, whose contractors are mainly western organisations. It is aimed at verifying that regulations, norms and standards used by these companies comply with the Ukrainian ones at every step of the licensing procedure.

| OPERATIONAL STEPS | RELEVANT DOCUMENTS | SNRA LICENSING STEPS |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <u>Siting</u> | Feasibility Study Report (FSR) scope of work | |
| | | Agreement for Site or Building Selection (only for ISFSF) |
| <u>Design</u> | Technical specifications for tender FSR Quality Assurance Document Reconciliation Document | |
| | | Design Licence |
| <u>Tendering process</u> | | |
| <u>Construction</u> | Preliminary Safety Analysis Report (PSAR) including detailed conceptual design, decommissioning plan, Environmental Impact Statement (EIS), overall pre-commissioning plan, quality assurance manual, | |

| | | |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| | reconciliation document | |
| | | Construction Licence |
| <u>Commissioning</u> | updated PSAR, overall performance test report, commissioning plan, temporary operation rules, tentative operative procedures, reconciliation document, certificates for equipment | |
| | | Commissioning Licence |
| <u>Operation</u> | Final SAR, operating rules, waste generation control, reconciliation document | |
| | | Operation Licence |

Table 1 : Licensing steps

Progress in evaluation of licensing documentation

The evaluation work is now in progress through both SSTC and Western TSOs. Riskaudit has not been involved in the site selection of facilities A and B and will not be involved in that step for facilities C, D and E for two main reasons :

- site licensing is an administrative step for most of the facilities to be built on Chernobyl NPP site since this one has been already licensed as a whole,
- for facility A, whose building is to be erected on the external border of the site, the procedure has been launched a long time before the signature of the contract between the EC and Riskaudit.

Nevertheless, the safety related aspects bound to site characteristics and industrial environment will be addressed while assessing the PSAR of the facilities.

The design licence is an administrative licence aimed at checking by the SNRA that the project is totally justified and acceptable and that the organisation set up before the beginning of the tendering process meets all the regulatory requirements. So, participation of Riskaudit was required neither at this level nor for the tendering process itself. SSTC however

participated to this phase, bringing its technical expertise to the PMU and OSAT to evaluate the safety issues in the proposals submitted by the bidders.

The tendering processes are over for facilities A and B and contractors have been selected. These are respectively a consortium composed of Framatome, Bouygues and Campenon Bernard for the facility A and a consortium composed of Tractebel, Ansaldo and SGN for the facility B. The tendering process for the facilities C to E, which have been merged into a single package by the OSAT, is in progress.

The work of Riskaudit, relating to the licensing development, has effectively started in parallel with the steps of construction licences for the facilities A and B.

The PMU is delivering parts of the PSAR of the facilities to the SNRA, which asks Riskaudit expertise for these documents. The schedule is very tight and it has therefore been necessary to set up a task force to perform this evaluation between October 1999 and end March 2000. The PSAR evaluation for the facilities C, D and E will probably take place during the first semester of 2000, but it will be dependent on the selection of the contractors, the proposed schedule and, probably, the decision which has to be made on waste categorisation.

The main tasks that will be performed by Riskaudit in the frame of the PSAR and, ultimately, the SAR evaluations should cover the following fields.

- process and specific hazards during operation and decommissioning, general and transversal problems,
- civil engineering : technical design, working design, construction, installation,
- technical engineering : process equipment, handling devices, cranes, ventilation, filtration, off-gas treatment, electric power supply, computer systems, infrastructure, media supply, storage of waste packages,
- radiological safety : radioactive inventory, confinement, dust prevention, radiation fields, shielding, criticality control, transportation, compliance with transport regulations,
- radiological protection of the workers : dose evaluation due to internal and external radiations, ALARA application,
- radioactive discharges : airborne discharge of radioactive substances, liquid discharge of radioactive substances, secondary radioactive waste generation, radiological consequences to workers and to the population,
- control and supervision equipment : personnel dosimetry, dose rate monitoring, control of effluent, control of environment, fire detection system, communication system,
- quality assurance system : process equipment (construction, materials), waste packages (tightness, corrosion), safety-related control equipment, ageing (corrosion, external aggression),
- operation : responsibility, organisation, personnel qualification, provisions for incidents, emergency response plan,
- accident analysis : external events, internal events, radiological consequences to workers and to the population,

- pre-commissioning testing programme, decommissioning.

The work has to be performed on the basis of existing Western practices (for the TSOs), Ukrainian regulations and additional regulatory documents prepared by SSTC in the frame of the present contract.

Moreover, Riskaudit has been involved since the signature of the first work order with the EC in a lot of transversal tasks aimed at providing assistance to the SNRA in the following fields :

- achievement of the consistency of the evaluation of the safety related documents of the five facilities. As the evaluation of the safety documents is to be performed by several organisations, interfacing problems which may evolve from the way the safety assessments are performed in different countries have to be clarified in time to avoid different assessments for similar safety problems. The platform for this work is the Technical Management Group (TMG).
- achievement of a common understanding of the general strategy proposed by the operator. The work will consist in assessing the basic approach related to decommissioning and waste management in order to evaluate later the feasibility and the design of the new facilities and their ability to deal with their expected efficiency.
- evaluation of the proposals regarding the steps of the licensing programmes for all the decommissioning facilities in detail. This work has been based in a first time on the description of the licensing programmes signed by the SNRA and Energoatom for the projects A and B. It will be extended ultimately to the licensing programmes which will be defined for projects C to E. This evaluation must be performed to clarify whether the steps of the licensing process and the anticipated content of each step will fulfil the requirements of an adequate way to get a licence, taking into account the existing Ukrainian and Western licensing practices.
- development of additional regulatory and technical documents associated to the licensing processes. The content of the safety documents which shall be submitted by the operator will be defined (e.g., different kinds of safety analysis reports, general operating rules, commissioning programmes).

These tasks, which cover for some of them the whole duration of the contract, constitute a fundamental work aimed at setting definitively up the licensing procedures related to waste management in Ukraine.

CONCLUSION

Selection of the contractors for the two first facilities and launching of the tendering process for the three last facilities are major achievements in Chernobyl NPP site cleaning.

These are the key elements to undertake the huge work consisting in processing and conditioning the waste and burnt fuels resulting from the Chernobyl 1, 2 and 3 units decommissioning in a near future.

In this context, Riskaudit has endeavoured to set up, in the framework of the contract of assistance to the SNRA all along the licensing procedure related to those facilities, to define clear working procedures with the members of the Western consortium, the Ukrainian safety body (SNRA) and its technical support (SSTC). After some difficulties during the first months following the signature of the contract with the EC, the structures have been finalised and everything is now ready to make the co-operation efficient.

The licensing schedules are very tight to comply with the EBRD requests. Each participant will have therefore to be deeply committed in the project to meet these schedule requirements. Provided some regulatory issues are solved by the Ukrainian authorities, such as waste categorisation, it can be reasonably anticipated that, with the current organisation, the facilities will be built and commissioned on time, complying thus with the deadline fixed by the EBRD, even if the objectives of some of them have to be refined to take into account possible developments in the Chernobyl NPP decommissioning strategy.

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