**Brief Summary of**

**the contribution of the IAEA TC programme to the first national NPP in Iran**

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of the IAEA TC assistance related to the Bushehr NPP in Iran

**Background:**

Turnkey contract for the construction, installation and delivery of two 1293 MW PWR units at Bushehr site was signed between the Atomic Energy Organization of Iran (AEOI) and German Kraftwerk Union (KWU) in 1975. Significant part of construction works and delivery of some equipment were completed by 1978, when the KWU suspended the implementation of the contract. In 1995 a contract for the completion of the first unit with integration of VVER-1000 MW type V-446 (modified version of 320 model) Russian technology with utilizing most of the KWU available buildings and equipment was signed between AEOI and Atomstroyexport (ASE), Russia, which in 1998 was upgraded to turnkey contract. The scheduled commissioning and start-up of the unit was delayed due to several complex reasons, and proceeded with: first criticality on 08.05.2011, connection to the grid on 03.09.2011, unit provisional acceptance on 23.09.2013, two refuelling conducted – first in February 2013, and second at the end of 2015, final acceptance certificate and licence for operation expected in 2016.

According to the contract signed in November 2014 between the NPPD and ASE for two additional NPP units VVER-1000 (latest modified AES -92 version) at Bushehr site, the final commitment and submission of documents for construction licence will be in 2015/early 2016, and the commercial operation of unit 2 in 2024 and unit 3 in 2026.

**The IAEA TC assistance** has contributed to the successful construction, start-up, commissioning and initial operation of Bushehr NPP unit 1 (BNPP-1). Continued assistance is being provided to the owner of the plant (NPPD), the National Nuclear Regulatory Authority (INRA) and to the Waste Management Department (INWM) as a “package” assistance in an integrated manner to:.

1. **NPPD** evolved from mostly an education type institution (1995-1998), through the development of core competences (1999-2003), to strengthening its capabilities with responsibilities as owner (2004 and beyond) through the projects:

* **IRA4024:** Infrastructure for Implementation of Nuclear Power Programme, **1995-1998**
* **IRA4029**: Strengthening Owner’s Function for BNPP-1, **1999-2004**
* **IRA4035**: Strengthening Owner’s Capabilities for Commissioning and Start-up of BNPP-1, **2005-2011**
* **IRA2011**: Strengthening and Upgrading Capabilities for Safe and Reliable Operation and Maintenance of BNPP-1**, 2012-2015**
* **IRA2013:** Enhancing the Level of Operational Safety and Reliability of the BNPP-1, **2016-2019**
* **IRA2012:** Increasing NPPD’s Capability in Planning and Implementing Activities related to Design and Construction of Two New PWR units in Bushehr with Emphasis on Safety, **2014-2017** (fully through GCS budget)

**As a result of the above projects, the following are the main achievements**:

* Comprehensive training programme and training centre were established, equipped with full-scope simulator (FSS), hardware and software for computer based training (CBT). The, qualification programmes and materials were developed, delivered and used for licensing of operational personnel. Specific training programme and comprehensive set of training materials were developed, delivered and used for extensive supervisory and management training of 54 high and middle level managers of NPPD and BNPP-1;
* The operating organization (BNPP-1) was established and the set of technical documents and commissioning and operation processes were revised and, improved. The associated procedures, turn-over packages from construction to commissioning and operation were developed. The management programmes for spare parts was established. The specialized technical support capabilities for safe and reliable operation and maintenance was established. Knowledge on advanced maintenance methods, materials, tools and on modern methods of outage management, optimization strategy and risk monitoring in BNPP-1 operation was enhanced.
* The offsite environmental monitoring and control center, laboratories and monitoring stations were established. The routine and post-accident radiation environmental monitoring was strengthened. In addition, the technical specifications for specialized software was developed and purchase of the software is under consideration.
* The BNPP-1 physical protection system, emergency preparedness and response plans were established. The organization and structures of emergency repairs teams and requirements for portable and mobile equipment have been determined
* The advanced nuclear material accounting and control (NMAC) system is established using the STAR software and practical training of staff through the TC support. Enhanced BNPP-1 capabilities for the development and implementation of Severe Accident Management (SAM) Guideline. The capabilities for Probabilistic Safety Analyses (PSA) was also strengthened. The technical specifications for a specialized Risk Spectrum software was finalized and currently in its final stage for purchase.
* Established owner’s specialized organizations to support safe and reliable operation and maintenance of BNPP-1, as follows: Safety Development and Promotion Company (Tavana), and Maintenance and Repair Support Company (Tapna).
* Contracts between the owner (NPPD) and operation organization on operation and maintenance and on Radioactive Waste Management of BNPP-1 were established and implemented.
* Significant contribution for incorporation and implementation of latest international standards, codes and best practices in enhancement of the safety in all phases of BNPP-1 project
* Increased capacity and capabilities in independent review and acceptance of safety reports for BNPP-1. Established technical requirements and specification of safety and operational performance indicators (PI) and training on software application that supports PI system management and its application.
* Strengthened capabilities in continuous improvement of integrated management system to promote and support strong ownership, safety and security culture. Established corporate (NPPD) and operation organization (BNPP-1) knowledge management (KM) system for utilization of available competence and expertise.
* Strengthened owner’s nuclear oversight strategy and enhancement capabilities in application of nuclear oversight functions.
* Strengthened owner’s capabilities for successful discharging their responsibilities for safe and reliable operation of the first national NPP unit

**Outcome**:

The first NPP unit at Bushehr has been successfully commissioned, reached full (100%) power on 3 September 2012, turned-over to the owner in summer 2013, and proceeds with its initial operation, producing electricity to alleviate high electricity demand in the country and with large spin-off effects to the whole national infrastructure.

**The following are the assistance to BNPP-1 in progress (under IRA2013):**

* IAEA OSART mission at the end of 2017 (preparatory visit in Nov. 2016)
* Development of ageing management programme
* Improvement of training system for maintenance and repair personnel, including maintenance training center
* Implementation of Severe Accident Management (SAM) programme, including severe accident (SA) analyses and scenarios
* Review of off-site emergency preparedness and response
* Strengthening environmental monitoring programme, including purchase and use of suitable software
* Improvement of the Integrated Management System (IMS), including safety requirements for compliance by services providers
* Application of new IAEA standards in modification of Main Control Room (MCR)
* Safety aspects of fresh and spent fuel engineering, including dray spent fuel storage at the site
* Modern methods of condition based maintenance for optimizing maintenance and repair programmes
* Improvement of the procurement system for goods and services
* Competency models, methods and assessment tools for effective personnel competence and performance management

**Areas for assistance on Design and Construction of Two New PWR units in Bushehr with Emphasis on Safety in progress (under IRA2012):**

* Development of comprehensive model for effective project management
* Group training programme on pre-construction management (completed in 2015 in China) and on construction and commissioning management (scheduled for 2016 in Republic of Korea)
* Knowledge management, design information management and configuration management throughout the whole NPP life cycle
* Risk management during preconstruction and construction phase of the project
* Development of local industry utilization plan
* Public information and awareness programme development and stakeholder involvement plan
* Review of selected training materials for the new units

Note: requests for additional areas of assistance are expected.

**Success factors/Lessons learned:**

* Significantly strengthened capabilities of the counterpart (NPPD and BNPP-1) in the continuous improvement of the project management system to promote and support strong ownership, strong Government commitment with high level of financial GCS allocations (including for a cost-free expert to support projects implementation), demonstrated the counterparts’ ability to absorb assistance provided.
* The management approach used during the implementation of projects included flexibility in planning and adjustment of work plan activities to reflect the progress of BNPP-1 project implementation and evolving needs of the end-user. Specifically, the following practices contributed to the success of the project: Elaboration of detailed action plans for implementation of activities with assigned responsibilities for each task; regular project coordination and review meetings, and permanent monitoring; closed follow-up on decisions taken; regular counterparts’ self-assessment; and tracking the implementation of recommendations. This management approach is founded on the proactive attitude of all project team members and responsible IAEA staff, supported by the respective SHs and DIRs in TC and TDs, with the strong assistance/support of the Special Project Coordinator.

**Challenges/areas for further improvement:**

* Urgent need to overcome existing difficulties in recruiting qualified and experienced external experts for field missions, as well as hosting scientific and technical visits of Iranian experts to relevant NPPs and organizations in the MS with mature nuclear power programme.
* Enhancement of the counterparts’ capacity building efforts by a broader exposure to the international safety best practices and approaches.
* Timely submission through official channels to the IAEA Nomination Forms for participation of national experts in activities outside Iran as defined in the workplan, and for SV/Fellowships.
* Timely submission to the counterparts of the End-of-Mission Reports (EMR) of completed work plan activities.
* Further strengthening the “package” approach in the BNPP related TC assistance to the respective counterparts (NPPD, INRA and INWM) in an integrated manner.
* Corporate KM system/portal to be strengthened to serve for retention and utilization of available knowledge, competence and expertise.
* Utilization of the video-conference approach for regular coordination between the respective project team members.

1. **INRA** under projects:

* **IRA9018:** Regulatory Infrastructure for Licensing and Control of Nuclear and Radiation Facilities, **2007-2011**
* **IRA9020:** Enhancing the Regulation of Nuclear Facilities and Radiation Activities, **2012-2015**
* **IRA9024:** Strengthening Regulatory Competence and Enhancing the Effectiveness of the National Nuclear and Radiation Safety Regime, **2016-2019**

**List of Priority areas of assistance to INRA**:

* In reviewing of all chapters of PSAR and selected chapters of FSAR draft, including seismic safety
* Regulatory control and licensing, including optimization of inspection programmes; development of national regulations and standards; emergency preparedness and responses; radiation and environmental monitoring; training of regulatory staff; assessment of safety cases of waste disposal facility; establishment of QMS; physical protection, nuclear safety and security culture

**Main outputs**:

* Strengthened knowledge in nuclear oversight, including review of safety documents and inspection programmes: 24 INRA staff were trained on safety assessment and regulatory inspections; a consolidated package of training material was delivered to be used for long term staff training.
* Demonstrated competency and self-confidence in functions performed on the construction, commissioning and start-up of BNPP-1
* Effective QMS focussing on safety adopted: the IAEA IRRS mission concluded the compliance of INRA’s regulatory system with the IAEA Safety Standards.

**Outcome**:

The assistance provided significantly contributed to the enhancement of the regulatory infrastructure and staff competency to effectively discharge INRA’s responsibility to perform regulatory control and licensing of BNPP-1 according to the international safety standards and practices

**Areas for assistance in progress (under IRA9024):**

* Further updating national safety regulations, requirements and guidelines in accordance with latest international standards and practices
* Further strengthening the capabilities for independent safety reviews and analyses, including utilization of proven safety computer codes and the completion of safety reassessment of BNPP-1 in light with lessons learned from Fukushima accident.
* Strengthening regulations for emergency preparedness and response, including severe accident management
* Further strengthening of regulatory staff competence
* Implementation of the nuclear oversight function
* Technical support capabilities in selected areas needed for safe and reliable operation and regulation of BNPP-1
* Strengthening regulatory control form protecting workers, public and environment during NPP normal operation and emergency situations
* IRRS follow-up mission, including some post Fukushima accident areas.

1. **INWM** under projects:

* **IRA9021:** Ensuring the Safe Construction of the TALMESI Radioactive Waste Disposal Facility, **2012-2015**
* **IRA9023:** Strengthening Owner’s Capability in the Safe Operation of TALMESI Radioactive Waste Disposal Facility, **2016-2019**

**Conclusions:**

* The very successful implementation of the comprehensive scope of assistance to the Iranian counterparts contributed significantly to the commissioning and initial operation of the first national NPP unit. The continuation of assistance is essential for its safe and reliable operation and maintenance, and for the construction of the two other NPP units at Bushehr in Iran.
* The IAEA TC assistance to the first national NPP in Iran can serve as a model for assistance to the interested Member states, considering introduction of nuclear power under Built-Transfer and/or Built-Own-Transfer (BOT) contractual approach.

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TCAP, IAEA