



## HUNGARIAN ATOMIC ENERGY AUTHORITY Nuclear Safety Directorate

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# RECENT DEVELOPMENTS IN NUCLEAR SAFETY IN HUNGARY

April 2010.

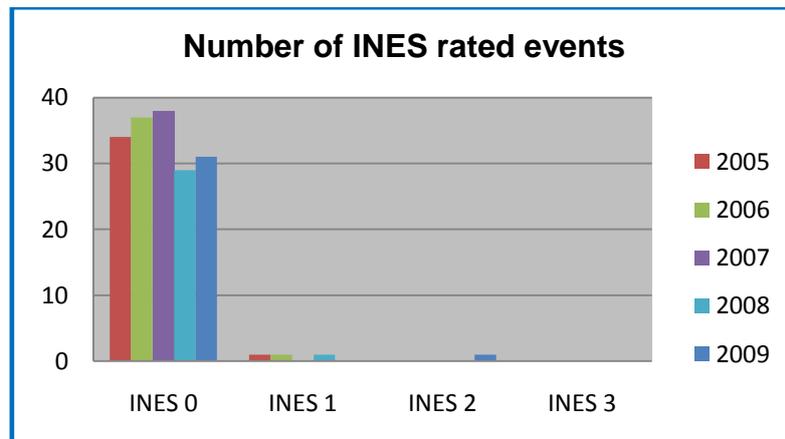
## General

### 1. Safety Performance of the Nuclear Installations

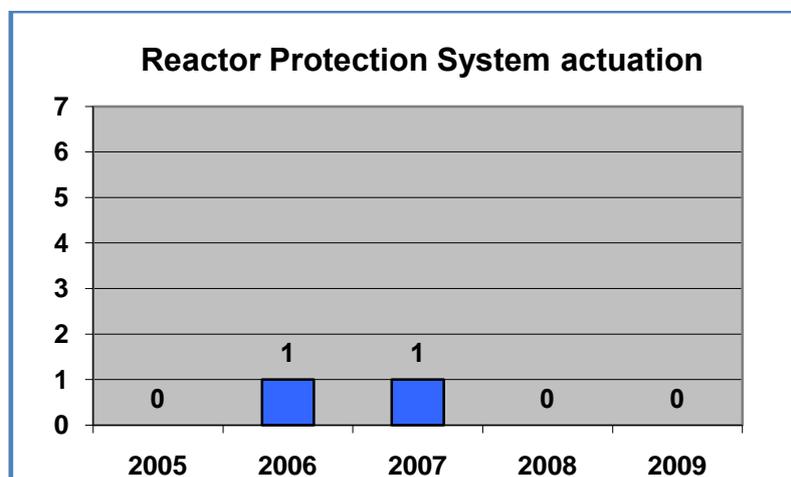
- Paks NPP load factors in 2009:

Unit 1	Unit 2	Unit 3	Unit 4
89.9 %	90.8 %	79.9 %	87.9 %

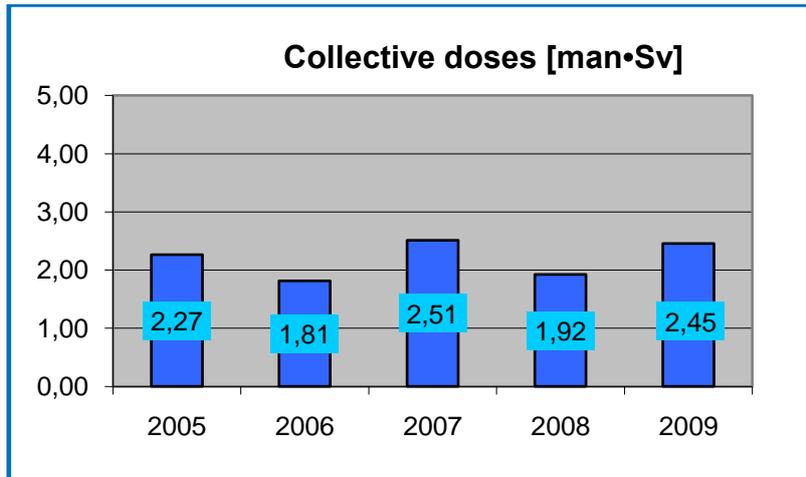
- 31 INES-0 and one INES-2 events have occurred in 2009. The INES-2 event was the drop of neutron detector chain on the reactor hall floor (see the event presented in our 2009/2 newsletter).



- Reactor protection system was not actuated during power operation.



- The collective dose was below 2,5 man\*Sievert in 2009.

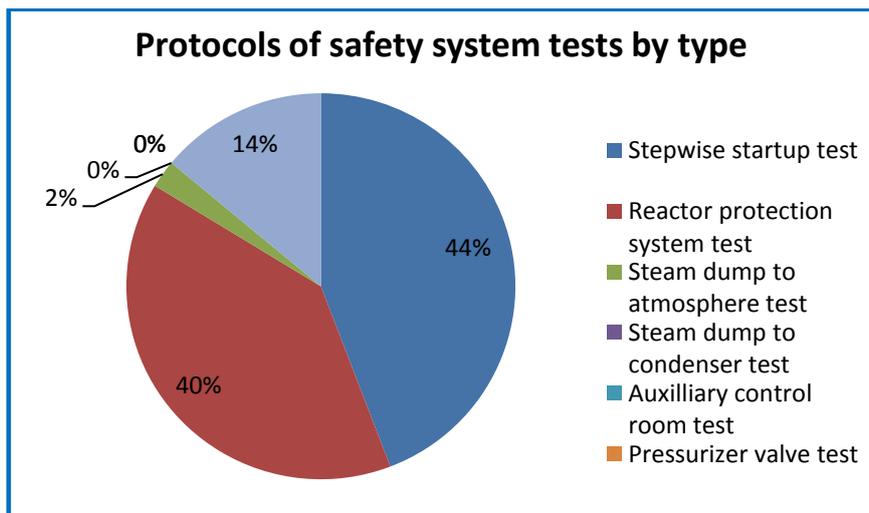


- The Paks Nuclear Power Plant, the Budapest Research Reactor and the Training Reactor have all operated in accordance with the relevant regulations.

## 2. Regulatory supervision in 2009

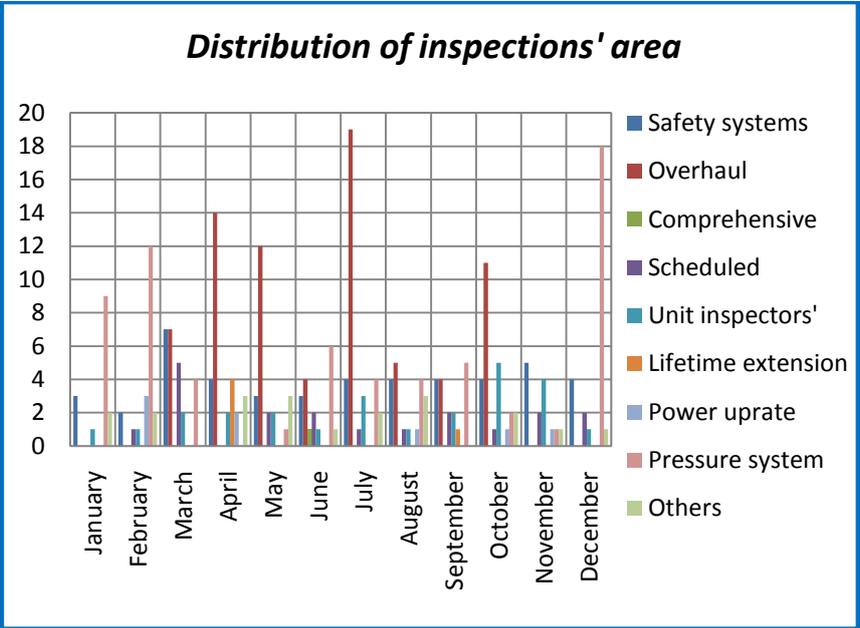
When designing the 2010 annual inspections a new scheduling period was introduced at the HAEA NSD to reduce the workload at the end of the year. The planning stage has been completed in November 2009.

HAEA planned two comprehensive audits at the Paks Nuclear Power Plant for 2009 but for the sake of the effective assessment of the lifetime extension program these had to be rescheduled to 2010. In addition, OAH has implemented five scheduled (targeted) inspections, related to fuel load cycles monitoring and management, to qualification of suppliers, to managing the in-core measurements, and the severe accident management project. The planned reconstruction of service pool No. 1 of the Paks NPP 3rd unit has not been started yet, thus the related inspection has been moved to 2010.

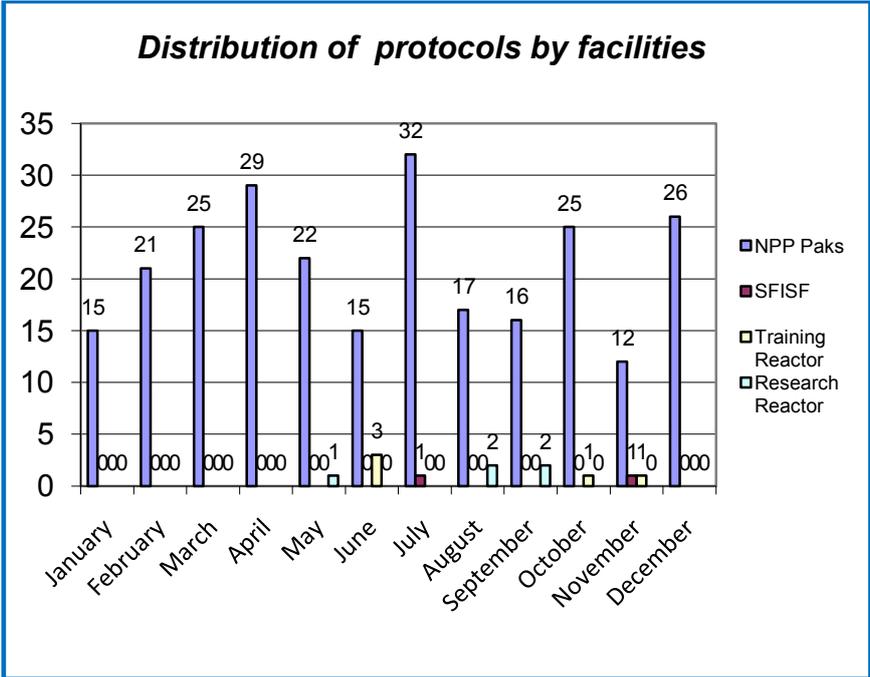


On an annual basis there were 267 specific regulatory inspections performed, and documented by Protocols. The most important ones among them were the cyclic tests of safety devices and systems (47), overhaul of NPP units (76), documentation of pressure system safety reviews (66), lifetime extension and power uprate (13). During the overhaul of units in 2009 HAEA NSD paid special attention to the conditions in the containment when

opening and the control of tidiness before the closing of the hermetic compartment. During these walk-downs the inspectors can directly experience minor failures which otherwise cannot be perceived by the control systems. This year the experience was positive as the premises were in order and clean.



The inspectors carried out 129 on-site inspections, verified the adequacy of the preliminary safety assessment of the proposed changes 358 times, and participated in 20 supplier qualification audits. Inspecting the training of the Paks NPP personnel HAEA NSD was part of the official qualifying exam team 45 times. The inspections by the dedicated unit inspectors (25) aimed at monitoring the operating conditions of the NPP units and the overall technical situation of the facility. The experiences in this area were also positive.



## **HAEA internal**

### ***1. Evaluation of Expert Groups operation***

Hungarian regulations assign financial means to finance R&D activity assisting nuclear safety regulatory work. Managing and harmonizing this R&D activity is a task of the HAEA. This process resulted in several safety analyses, regulatory guides and various safety related reports in the past decade. However, as a recent review pointed out, the utilization of these reports should be further enhanced.

To answer the above recommendation, expert groups have been established and are working at the HAEA since early 2009. The main purpose of establishing these groups was to enhance the utilization of R&D reports and to intensify the co-operation and the exchange of experience between colleagues of different generations. The task of the Expert Groups is the revision and commenting of the topical proposals and studies which are produced in the framework of HAEA's R&D program. Currently, ten expert groups are operating in various technical fields such as deterministic and probabilistic safety analysis, emergency preparedness, decommissioning, etc.

In January 2010 an evaluation of the first year of operation of the expert groups has been completed. Workload, membership, working fields and operation of the expert groups were examined during the assessment. Several corrective measures were suggested to make the expert groups more effective and to balance the workload between the members.

According to the main findings the aims and objectives set out were achieved, experiences of the first year are satisfying. R&D reports were evaluated with more attention and research fields were based on wider agreement than before.

### ***2. Regulatory Review of Paks NPP low power and shutdown PSA***

The HAEA NSD program on reviewing nuclear power plant safety analyses by using assistance of independent experts has been started in the beginning of the last decade. The review of PSA level 2 was followed by the review of the Level 1 PSA (nominal power rate and included internal fire and flood analyses). The results of those reviews make it possible to complete a quality assured and successful review of the PSA for low power and shutdown operational states. In 2009 the HAEA NSD Department of Technical Support has completed the preparatory tasks, in January 2010 the Science Advisory Board of Nuclear Safety Director made a decision to start the shutdown PSA review project in 2010, and to complete it in 2011.

The main goals of the project are to check compliance of shutdown PSA with national regulation, with professional and quality management recommendations and guides of HAEA, IAEA; and survey potential applicability of the shutdown PSA for PSA applications like Risk Monitor (Risk Watcher), Precursor Analyses, Real-time Risk Forecaster and for use in regulatory process.

The financial and regulatory human resources are being assigned to the project, the quality management plan of the project and contracts with independent experts will be formulated by the 3<sup>rd</sup> quarter of 2010, shutdown PSA model and documentation will be upgraded by the end of 2010, which means that the kick-off meeting of the review phase will be held in January 2011.



*Face to face (NPP Staff vs. Review Team) at the time of the level 1 PSA review in 2008*

### ***3. HAEA Training plan for the year 2010***

The annual training plan for 2010 of the HAEA was prepared in January. The HAEA provides a wide variety of training programs for the staff. The annual training plan takes into account the comments and proposals obtained in the self assessment of the HAEA training system. The plan foresees 32 programs and 10 exercises. The main training topics are: safety classification, radiation protection, severe accident processes, legal changes, preparedness and response for nuclear or radiological emergencies, theoretical training on analysis methods, application of analysis tools, and application of communication and computer tools.

Classroom training, on-line training and practical exercises are distinguished in the plan. On-line training is used mainly to refresh how to apply software tools. The advantages of the on-line training are that it can be performed when the participant can find suitable time for it, and also the tutors can check how the participant has solved the given task. Classroom training is a traditional training form where the audience is in contact with the lecturer. Lecturer can be a staff member of the HAEA or an external expert. The training plan includes various exercises: alerts, methodical, table top and full scope exercises for the Emergency Response Organization of HAEA.

## **Nuclear Power Plant Paks**

### ***1. Power Uprate***

The Paks NPP operates four VVER-440/213 type reactor units, originally designed to produce 1375 MWth and 440 MWe each. Earlier upgrades of the secondary circuit and turbine resulted in about 470 MWe with an unchanged thermal capacity at all four units. Recently an upgrade of the primary side has been performed to increase the nominal power by 8% to 1485 MWth, resulting in about 500 MWe generated power by each unit. The power increase is primarily reached by refined primary pressure regulation, core control system upgrade and a new type of fuel assemblies. Additional modifications have been performed in certain technological components, e.g. replacement of some of the MCP impellers and decrease of initiating pressure value of the hydro-accumulators. By the end of 2009 the upgrading process has been completed successfully on the four units.

### ***2. Preparations for Primary-to-Secondary leak (PRISE) Initiating Events***

The possibility of such containment bypass events was revealed as a serious deficiency of the original design and licensing bases by the Hungarian AGNES Project and by the IAEA Issue Book in the 90s. A very comprehensive safety upgrade process was defined and approved as part of the first Periodic Safety Review of Paks NPP Units 1÷4. Along the years

all but the last technical measures were designed, approved and implemented. The only remaining issue is to preclude the consequences of two-phase or water phase blow down through the SG safety valves and/or of a water hammer in the main steam-lines resulted from a PRISE event.

After some unsuccessful design and approval attempts the accepted technical solution contained a separate gate valve group and a diffuser attached to the water part of each SG and allowing blowing down the secondary side of the leaking SG before having two phase or water flow through the safety valves or a water hammer. It was intended to be fully implemented on Unit No. 3 last year.



During the installation work scheduled for the general overhaul of the unit it was impossible to ensure the tight closure of the supplied valves. An extensive review of the possible causes and of an improved manufacturing and montage technology was carried out involving the designer and manufacturer organizations. This year it is planned to install the accordingly modified gate valves during the overhaul on the Unit No. 4, and - based on the experience gained there - to execute some preparatory activities on Units No. 1 and 2.

*The figure shows one of the mounted and later demounted blow-down gate valve group and diffuser*

### ***3. Regulatory oversight process of organizational changes proposed by the Paks NPP in 2009***

To adapt the operating organization of the Paks NPP to the actual goals and tasks the NPP management decided to initiate organizational changes. Among them there was one with strategic importance: creation of a new, small directorate, allotted with the task of initial preparatory activities to build an additional new unit to the NPP.

The changes were introduced by 1st of January 2010. It is worthwhile to mention the reallocation of the quality management issues to an organizational unit connected much closer to the DG than it was earlier, maintaining a suitable framework to contract most of the QC activities formerly performed by the plant staff and combination into one department the radiological safety and environmental safety issues.

The follow-up inspection by HAEA NSD of the reorganization is planned for the spring 2010.

### ***4. New type fuel at the Paks NPP***

Following the power uprate of the reactor units and also for economical reasons a new fuel type with higher enrichment was introduced at the Paks NPP. As a result of this both the amount of necessary fresh fuel and the amount of the spent fuel decrease. Another important feature of the new fuel is its burnable poison contents, which is meant to increase operational safety.

The introduction proceeds step by step according to the international practice, assuming a HAEA license at every step. The first test fuel assemblies were used in Units 3 and 4. The first full scale use is expected for the year 2010 and the use of the new fuel will be overall in 4-5 years. In the transitional period mixed cores are used (the present and the new fuel types are used together). Due to this, the core design, the surveillance and control of operation requires increased attention. The license in principle for the modification process was issued in 2009. The preliminary assessment of the results for the test fuel assemblies shows that the new fuel can be handled and operated on the basis of the present technical conditions at the Paks NPP.

Experience so far gained suggests that the control measurements of the fuel assemblies following the fuel fabrication process have to be supplemented by a further investigation to prove the coincidence of axes of the different parts of the fuel assemblies.

## Other Nuclear Installations

### 1. Conversion to low enriched fuel takes place at the Budapest Research Reactor

The conversion of the fuel of Budapest Research Reactor has begun in the autumn, 2009 according to the license issued by the HAEA. Mixed core – containing highly enriched fuel used so far and new, low enriched fuel – will be set up in four cycles, in which the amount of new fuel will be gradually increased, while the old type will decrease. The fifth campaign will include low enriched fuel only. The change will thus take a bit more than 3 years.

The operator KFKI AEKI prepared an evaluation report on the experiences of the first fuel cycle with mixed core, following the requirements of the conversion program approved by the authority. The Safety Committee of BRR agreed to continue the campaign based on the preliminary assessment of the report. The Nuclear Safety Directorate of HAEA assessed the report and examined the data of reactor physics measurements belonging to start-up, operation and shut-down of the reactor, the results of the coolant and gas sampling, and the comments of the research teams using the experimentation channels of the reactor. The authority confirmed that the characterizing parameters of the fuel cycle conducted in December, 2009 were in accordance with the expectations based on the preliminary calculations. During the temporary operation no abnormal conditions have developed and no reportable event has occurred. The HAEA has approved to continuation of the operation as scheduled on the basis of the experiences gained during the 234 hour operation with the first mixed core.



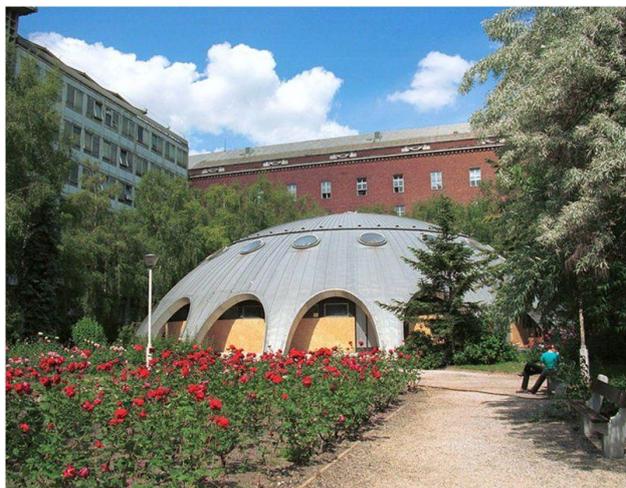
Control room display of the mixed core

## ***2. Reconstruction of the fire-alarm system at the Training Reactor of Budapest University of Technology and Economics***

The fire-alarm system of the Training Reactor (TR) of BUTE did not meet the actual legal requirements due to loss of smoke and heat sensors, manual signaling equipments in many of the premises. The fire-alarm system was not able to incorporate more sensors due to its design. The HAEA prescribed the reconstruction of the fire-alarm system of the facility on the basis of the Periodic Safety Review (PSR) of the TR. The signaling centre was replaced by an up-to-date one and a signaling system complying with the requirements was installed. During the reconstruction, due to safety reasons, the reactor was shut down, and temporary measures were entered into force to maintain fire protection. The new system was put into operation in the presence of the HAEA NSD and of the state fire protection authority, and its use was approved.

## ***3. Compliance with Periodic Safety Review requirements at the BUTE Training Reactor***

On the basis of the Periodic Safety Review (PSAR) the HAEA ordered safety enhancements and modifications at the BUTE Training Reactor. In the year of 2009 the Training Reactor completed the modernization of the radiation protection control system and the reconstruction of the fire alarm system. They have also carried out a reconstruction to increase efficiency of the ventilation. Design and prototype production of the new equipment have been started to upgrade the reactor safety system. The preparation for reconstruction of in-core nuclear detector chains with up-to-date electronics is in progress.



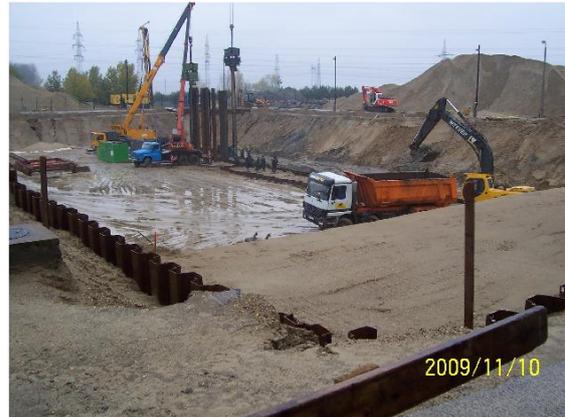
*BUTE Training Reactor*

The HAEA monitored the completion of the ongoing changes and improvements determined in the PSAR. In relation with PSAR the authority formulated a number of prescriptions to update, supplement and enhance the documents which establish the safety of the facility and control the operation. On-site scheduled inspection has found that the significant safety enhancement installations absorb the human resources, resulting in a delay in committing the obligations in a part of document enhancement tasks. The HAEA NSD initiates measures in order to facilitate the liquidation of the delay.

## ***4. Extension of Spent Fuel Interim Storage Facility (Phase 3)***

After completion the extension Phase 2 of SFISF in 2007 preparations began to build extension Phase 3 with the chambers 17-20. The groundwork was held back in 2009 because of soil instability. This difficulty has been solved by soil replacement, thus the foundation works could began in 2010.

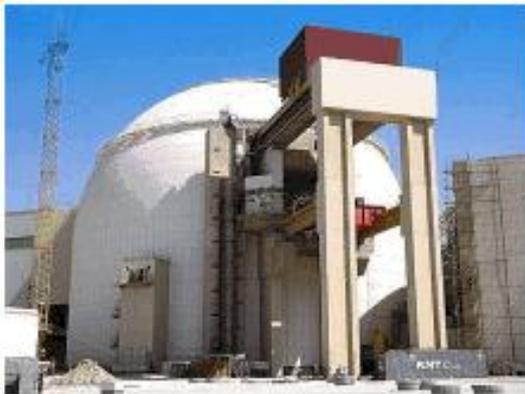
Because of the delay it was necessary to extend the duration of the construction permit. The manufacturer purchased the raw materials to construct the steel structures to be mounted in, and HAEA NSD has made preparations for the licensing procedures of the technological equipment. A monitoring plan has been prepared for the site inspection of the manufacturing.



Foundation works of SFISF extension Phase 3

## International co-operation

### 1. HAEA participation in IRRS mission in Iran



Bushehr NPP in Iran

An IAEA IRRS review team, invited by the Iranian government, was sent to Tehran to review the work of the Iranian Nuclear Safety Authority (INRA). This review took place from 19th February to 2nd March, 2010, with the participation of experts from eight countries. Mr. Iván Lux, HAEA Deputy Director General also took part in the work of the expert group. The reduced scope IRRS review focused on the Iranian regulatory activities aimed at the Bushehr NPP.

### 2. TRANEM training courses

HAEA has won the tender by the European Commission on holding TRAINING courses on Nuclear Emergency Management (TRANEM) for the professionals of the member states and candidate countries of the European Union. In the framework of the contract HAEA will host the courses between 2010 through 2012. The objective of the courses is to give an overview on nuclear emergency management and to strengthen the cooperation between member states of the Union.

European Training Course on Nuclear Emergency Management 13-17 September 2010, Budapest		European Training Course on Nuclear Emergency Management 13-17 September 2010, Budapest		European Training Course on Nuclear Emergency Management			
<p><b>Course activities</b></p> <p>The course will be conducted via:</p> <ul style="list-style-type: none"> <li>- classroom training in form of lectures</li> <li>- practical training (demonstrations, exercises and tests)</li> <li>- moderated discussions for sharing trainees' experiences and</li> <li>- evaluation of activities</li> </ul> <p>Course activities will be held in the CERTA crisis centre which is dedicated to the emergency response activities of the HAEA. The centre, used exclusively for nuclear emergency analysis, training and exercises, comprises of a well equipped central room for crisis management and a separate training centre for courses and demonstrations.</p> <p><b>Venue</b></p> <p>The course will be held at the Headquarters of the HAEA. Address: Fényes Ador utca 4., Budapest, Hungary, H-1026.</p>		<p><b>Financial arrangements</b></p> <p>There is no participation fee. Coffee, beverages, the welcome dinner, course handouts and lecture notes are provided free of charge. Travel expenses, accommodation costs and possible daily allowances are however not covered.</p> <p><b>Registration</b></p> <p>A registration form can be downloaded from the webpage of the course and submitted electronically, before 30 June 2010 to <a href="mailto:tranem@haea.gov.hu">tranem@haea.gov.hu</a>.</p> <p><b>Accommodation</b></p> <p>Hotels nearby offer special corporate prices. Details regarding the available hotels and booking info can be found on the course webpage.</p> <p><b>Additional information</b></p> <p>Detailed information about the course can be obtained on the course webpage, or personally via: Web: <a href="http://www.haea.gov.hu/tranem">http://www.haea.gov.hu/tranem</a> Phone: +36-1-4364908; Fax: +36-1-4364909 Email: <a href="mailto:tranem@haea.gov.hu">tranem@haea.gov.hu</a></p>		<p><b>TRANEM</b> <a href="http://www.haea.gov.hu/tranem">http://www.haea.gov.hu/tranem</a></p> <p><b>13-17 September 2010 Budapest, Hungary</b></p>			
<p><b>TRANEM TRANEM TRANEM</b></p>							

TRANEM course announcement

The course is open to about 30 participants and is primarily dedicated to young and newcomer staff of competent authorities, governmental organizations, nuclear and radiological facilities nominated from EU member and candidate states. The course is divided into 29 units including class room and practical training, moderated discussions, evaluation tests, a course drill and feedback. The first course will be organized during 13-17 September 2010 at the HAEA headquarters. More information is available at the website of the courses from where the registration form and the course program can also be downloaded: <http://www.haea.gov.hu/tranem>.

### ***3. Training of Iranian nuclear safety authority staff in Hungary***

The International Atomic Energy Agency (IAEA) - on Norwegian initiative and funding – launched a project to help to prepare the Iranian nuclear safety authority staff for supervision of the recently completed Bushehr NPP. The authorities of VVER type NPP operating countries were asked to take part in a preliminary training for Iranian inspectors then continue their training and transfer the experience in their home country, involving participants in the daily regulatory work as well.

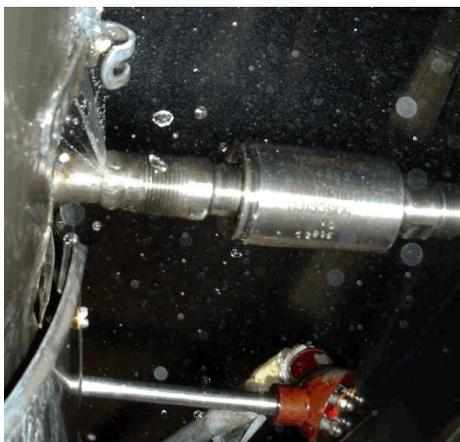
Since the safe use of nuclear energy for peaceful purposes is a common interest, Hungary is ready to assist and pass work experience to the nuclear power plant operating countries, provided that the transfer of experience happens under the IAEA's initiative and guarantee. The HAEA – following the appropriate domestic negotiations – participated in this project in the topics of safety evaluation, monitoring and on-site training.

Seven Iranian specialists take part in practical training of supervising the nuclear power plant in two groups. The training takes place in the HAEA headquarters and in the Paks Nuclear Power Plant. This training will help in the safe operation of the nuclear power plant which is fully supervised and controlled by IAEA. However, it should be emphasized that the knowledge gained by our training cannot be used for purposes other than the operation of power plants for peaceful purposes.

We are confident in that the Hungarian contribution will facilitate the safe operation of the Bushehr NPP.

## **Events of Interest**

### ***1. Primary leak at the Paks NPP Unit 1***



*Leak on the sampling system pipe*

In the afternoon of 16th November, 2009, the operating staff of Paks NPP Unit 1 experienced increasing steam content under the reactor dome and simultaneously the level of a degassing tank was decreasing. The containment water leakage flow increased to ~300÷600 liters per hour and the radiation level elevated in the venting systems.

The NPP staff started the checking as prescribed in the operating manual. Next morning the leaking pipe was identified and isolated from the primary coolant system thus the discharge was stopped. The reactor was stopped and spot checks were carried out thereafter. It was found that at the weld on a small-diameter sampling pipe a cracking formed, causing the leak.

Event investigation has revealed that the route of the sampling line was changed during reconstruction of the Radiation Monitoring System in 2008, but the leaking part of the line was not affected. However, during the demolition of the old measurement system a scaffold was built near the pipeline, and radiation shields were placed there to ensure the safe working conditions. Then the pipeline might have been damaged, but this could not be demonstrated later on. To determine the cause of the fracture, material testing of the damaged pipe section was ordered.

The event resulted in about half a day loss of energy production, but no significant safety risk was identified.