HOTLAB-2014

Report of Contributions

Contribution ID: **2** Type: **Oral**

Quality Management in a HOTLAB – Challenges & Solutions

Wednesday, September 24, 2014 9:00 AM (30 minutes)

As nuclear installation at Paul Scherrer Institute (PSI) the department HOTLAB (AHL) is obligated by the Swiss regulator to serve a management system according to the IAEA Standard GS R-3.
The Laboratory of Nuclear Materials (LNM) as well as the AHL have to fulfill the ISO 9001 standard as a major request from their customers site (fuel industry and Swiss power plants).
As consequents AHL and LNM have set up a common quality management system (QMS) according to ISO 9001 (SN-EN-ISO-9001) and obtained their certificates in 2007. Since the starting of the QMS in the HOTLAB (first certificate 1999 with the predecessor organization) the constraints and requirements increased continuously.
After a first phase of the implementation of the QMS the predecessor organization decided to develop the management system on the basis of the commercial software IQSoft of the company IQS Ltd. in Zofingen (CH). The system was implemented in 2005 in the former Microsoft Access based program, mainly using the modules document management, continuous improvement process, as well as the resource management.
In 2010 it was decided, due to the development of the software, to migrate the database on a MSSQL server. With the increased demands on the regulator body the use of the database IQSoft has been intensified. In 2013, a since 1990 used maintenance program including all historic data was integrated into IQSoft. The IQS AG itself is currently developing the application further in terms of web and app functionality. With the new mobile solutions, user-friendly presentations and applications can be realized inexpensively and effectively. This increases the acceptance of the whole management system among the employees.
This presentation shows the past development, the occurred challenges and found solutions as well as the envisaged further future developments. The Swiss regulator has commended the system as exemplary at their last inspection. The PSI HOTLAB QMS might become a successful example to others.

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Presenter: Mr ZUBLER, Robert (Paul Scherrer Institut)

Session Classification: Administrativ Tool

Track Classification: Administration Tools

Contribution ID: **3** Type: **Oral**

Integrated Mangementsystem in a modern HOTLAB

Wednesday, September 24, 2014 9:30 AM (30 minutes)

For the detection and control of nuclear fuel samples and monitoring with respect to criticality safety, the 1998 from PSI developed KBuch program has been used. In autumn 2011, a logic error was detected in the software during a routine booking with extraordinary nuclear fuel. This bug was reported to the national regulator ENSI and appropriate administrative measures have been taken to prevent the recurrence of the logic error.
ENSI additional requirement: "Given the fact that the logic fault is inherent and can' t be resolved in the short term, effective measures to prevent future accounting errors must be taken to medium term. The software should be developed to state of the art as soon as possible".
Subsequently, a project was launched to update the used software as required.
In a first step a total situation analysis was performed. It was clearly seen that today's program Kbuch has many interfaces to the QM system (users, facilities, containers, …) , as well to the present sample management software. Those interfaces have been identified to be potential sources of errors in the current situation.
The decision was taken at PSI to start a complete new development of the software instead of performing only an update of the existing program. This decision allows the development of the software to current state of the art, improves update capabilities in the future and allows the restructuring of the software (kernel, GUI, interfaces).
In spring 2013, five software companies were invited for bidding. From this call the company IQS Ltd. in Zofingen (CH) was chosen as a partner for the now following phases.
In summer 2013, the concept of the new planed program was presented successfully to the regulator.
The known potential of the standard software IQSoft from the chosen project partner IQS Ltd, leads to the idea of an integrated management system at PSI HOTLAB.
This presentation shows on basis of the IQSoft standard software the status of the actual project to an integrated management system in a modern HOTLAB

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Session Classification: Administrativ Tool

Track Classification: Administration Tools

Contribution ID: **4** Type: **Oral**

FIXBOX 3 – FIRST RESULTS FROM THE PSI HOTLAB LIQUID WASTE TREATMENT FACILITY

Wednesday, September 24, 2014 4:00 PM (30 minutes)

In nuclear research it is most important to gain efficient solutions in waste management following all terms to content all involved parties.
Within the PSI HOTLAB liquid waste treatment facility called "FIXBOX" liquid radioactive waste is conditioned to be submitted to intermediate storage or final disposal as cemented solid drums.
Recently, the third generation of the FIXBOX is in its testing phase, relying on the experience of its previous versions and new ambits in nuclear science.
Results from the first active tests are presented here.

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Presenter: POTTHAST, Heiko-Dirk (Paul Scherrer Institut)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **5** Type: **Oral**

FIB/SEM in a Hot cell

Tuesday, September 23, 2014 1:30 PM (30 minutes)

Abstract for HotLab-2014 conference

FIB/SEM in a hot cell
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Introduction
A FIB/SEM is an instrument combining a Focus Ion Beam and a high resolution field emission Scanning Electron Microscope. It provides many capabilities for ion and electron imaging, material deposition and ablation of materials. In case of Radioactive sample characterization, attentiveness is strongly required to avoid detectors and electronic devices damaged by radiation, radioactive sputtered material redeposition and personal protection.
Many solutions have been carried out to overcome these constraints.

Method
In the project study, basic data give the maximum sample activity evaluated between 1 and 12 Ci (1 Curie = 3,7.Bq) and Gamma dose rate measured at 5cm of 1Gy/h. The different detectors that have to be protected against radiation are EDS (Energy Dispersive Spectrometer), EBSD (Electron Backscattered Diffraction), SE detector (Everhart-Thornley). For EDS and EBSD, an automatic movable shield in Densimet© is used to protect those detectors in retracted position. The SE detector has been modify using a bended light guide to avoid direct Gamma rays to hit PMT (Photo Multiplier Tube) and Pre-amplifier.
With Electronics devices and control unit outside the Hot cell and the instrument remotely controlled, operators work in safe conditions, for this purpose, all cables are lengthened.
To keep external parts of instrument clean and to avoid contamination, the FIB/SEM is connected sealed to a glove box. An assembly type DPTE system is used to maintain confinement and allow FIB/SEM Glove box separation in case of service maintenance needs.
Sample manipulation is an important point, so mechanical solution has been found to avoid sample fall in the glove box or inside FIB/SEM chamber. Two edged tray are placed above and under motorized stage. Because sample transfer requires operator action a STM (Sample transfer Module) has been developed to secure sample manipulation with ball joint arm or telemanipulator arm.
As mentioned above, A FIB system is used mainly for ablation of material and a fundamental question has been raised : "Where do sputtered materials go ". For this purpose a scientific study has been carried out to determine angular distribution of sputtered particles, an innovative solution has been found out.

Conclusion
In one of those projects, other developments have been carried out like, Retractable NanoIndentor and Micromanipulator. A removable STEM detector is also available.
In one of this project, the difficulty was to adapt the FIB/SEM with its dedicated glove box in an existing hot cell
All these developments comply with CEA regulation and safety and some of them are actually in the way to be patented.
The first FIB/SEM nuclearized will be installed on site in July and the next one in October 2014.

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Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **6** Type: **Oral**

Experience in maintenance and decommissioning of in-cell equipment of an operating alpha, beta, gamma hot cell facility.

Tuesday, September 23, 2014 3:30 PM (30 minutes)

Radiometallurgy Laboratary (RML) at the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam consists of seven concrete shielded α,β,γ hot cells, each having a floor area of 5.5m x 2.1m and wall thickness 1200 mm, designed to handle up to 3.7X107 GBq activity (gamma,1 MeV). The hot cells are maintained in inert gas (nitrogen) atmosphere for handling reactive and pyrophoric fuels. The cells are equipped with remote handling devices and alpha-tight fuel transfer systems to carry out various non-destructive and destructive examinations for metallurgical characterization of the mixed carbide driver fuel of Fast Breeder Test Reactor (FBTR), core structural materials and various test fuel and structural materials irradiated in FBTR. The hot cells have been continuously in operation for the past twenty years during which multitude of post irradiation examination (PIE) campaigns have been undertaken including those on the mixed carbide driver fuel, control rods, nickel reflector subassemblies of FBTR and a fuel subassembly with MOX fuel and D9 alloy clad and wrapper proposed to be used in the 500 MW Prototype Fast Breeder Reactor (PFBR).

The remote handling devices and hot cell equipment facilitate advanced techniques including laser based dismantling, helium leak testing, eddy current testing, X-radiography, neutron radiography, gamma scanning, fission gas analysis, metallography and tensile testing. During the use of these hotcells, a few obsolete systems as well as accumulated consumable and hardware wastes have been packed out and new systems installed to increase the capabilities and to meet new requirements. In general, all the systems have performed well so far with minimum interruptions for remote maintenance. The concept of modularity adopted for in-cell equipment has paid rich dividends during these campaigns. Minimally invasive techniques which involve the use of custom-built man-entry systems have also been adopted occasionally to carry out major repairs as well as dismantling and decommissioning of old equipment with minimum man-rem expenditure. Due to the increasing failure of components caused by ageing and extreme radiation levels in the hot cells, these techniques need to be refined further to embark on a major refurbishment of the hot cell facility, to adapt it for advanced fuels.

This paper describes salient design features of the hot cell facility and case studies of major campaigns for repair / replacement / decommissioning and disposal of various in-cell equipment/ hardware. Experience gained and the safety measures employed during such campaigns will also be highlighted.

Key words: Hot cells; remote operation; fast breeder test reactor; fuel subassembly; post irradiation examination; decommissioning; refurbishment.

Summary

This paper describes salient design features of the hot cell facility established at the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam and case studies of major campaigns for repair / replacement / decommissioning and disposal of various in-cell equipment/ hardware. Experience gained and the safety measures employed during such campaigns will also be highlighted.

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Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **7** Type: **Oral**

Determination of hydrogen concentration in Zircaloy cladding using hot vacuum extraction method with two-step heating

Monday, September 22, 2014 2:00 PM (30 minutes)

The amount of hydrogen absorbed to the fuel cladding increases by extended burnup fuel. The absorbed hydrogen that exceed solid solubility limit precipitates as the hydride phase. The high concentration of hydride causes the fuel cladding embrittlement which might become the origination of fractures of the cladding. Therefore, it is important to measure the hydrogen content in the cladding to estimate the safety margin of the irradiated cladding. Hydrogen is absorbed not only in the cladding metal phase, but in the oxide layer. To evaluate the embrittlement of the cladding, it is necessary to measure the hydrogen content in the cladding metal phase and oxide layer separately. In the previous method of hot vacuum extraction, the hydrogen absorbed to the fuel cladding which strongly influences the cladding embrittlement was not able to be measured correctly because the amount of hydrogen released from melted cladding together with the oxide layer was measured. Therefore, the new device which can control the heat temperature was employed to measure the amount of hydrogen in the metal phase and the oxide layer separately by the two-step heating method. This paper shows the technical review of measuring method including the technique for the determination of extraction temperature.

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Presenter: Mr OBATA, Hiroki (Japan Atomic Energy Agency)

Session Classification: PIE

Contribution ID: **8** Type: **Poster**

Development of Low Cyclic Fatigue Test Technique for irradiated Cladding Tube in Hot Laboratory

KAERI's R&D group had produced a lot of low cycle fatigue data for an un-irradiated fuel cladding tube using a cyclic pressurization device. However, the infrastructures and fatigue test techniques, which can produce the fatigue data on the irradiated fuel cladding tube, are still worse off in Korea. Therefore, the objectives of this study are to develop low cycle fatigue test techniques for irradiated fuel cladding tube, as well as produce a stress-life curve of the irradiated cladding tube under the cyclic pressurization.

The cyclic pressurization fatigue test machine was newly developed and installed in hot laboratory at KAERI's post irradiation examination facility. Non-flammable silicone oil was used as a medium to exert an internal pressure on the cladding tube. The hydraulic cylinder moves up and down to apply a cyclic pressure to the cladding specimen so that the pressure of the cladding can be controlled within the range of 0 to 100 MPa, and the resultant hoop stress ranges up to 780 MPa. The loading frequency can be controlled in a range of 0.5 to 2 Hz with a sawtooth and sinusoidal waveform.

Radiation shielding system that surround the irradiated cladding specimen and the electric furnace was installed to protect the tester and minimize the radiation exposure from the spent fuel cladding specimens. Based on the shielding calculation results produced by the MCNP5 code system, the shielding material is determined to be rectangular shaped pure lead with a 50 mm thickness. In addition, the lead structure is covered with a 5 mm thick stainless steel casing.

To exert an internal pressure inside the irradiated cladding tube specimen, it is essential to remove the spent fuel pellet from the fuel rod. So defueling machine which can remove the spent fuel pellet from 300 mm long irradiated cladding tube specimen was developed.

In Addition, remote handling fitting fastening apparatus was equipped in hot cell. This apparatus was designed to fasten the high pressure fitting to defueled cladding tube specimen remotely using manipulator. The fatigue test specimen clamped with high pressure fitting guaranteed the non-leakage performance during cyclic pressurization.

Using these developed test systems, fatigue behavior data of the un-irradiated advanced Zircaloy cladding tube w/ and w/o hydrogen have been produced from this study. In addition, the preliminary fatigue test for an irradiated advanced Zircaloy cladding tube was also carried out successively.

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Presenter: Mr JANG, Jeongnam (Korea Atomic Research Institute)

Contribution ID: **9** Type: **Oral**

COST-EFFECTIVE PRECRACKING OF PCCV SPECIMENS FOR FRACTURE TOUGHNESS TESTING BY USING A PIEZO-ELECTRIC ACTUATOR

Wednesday, September 24, 2014 1:30 PM (30 minutes)

Experience has shown that it is practically impossible to obtain a reproducible, sharp, narrow machined notch using conventional manufacturing techniques that will simulate a natural crack well enough to provide a satisfactory fracture toughness test result. Consequently, all specimens used for the determination of the fracture toughness of metallic materials must contain notches sharpened with fatigue cracks. The fatigue crack is produced by cyclic loading the notched specimen on a servo-hydraulic testbench or resonant fatigue testing equipment.
The evolution in the ASTM standard to more stringent precracking requirements and the large amount of fracture toughness tests annualy performed at SCK-CEN, was the motivation to search for novel techniques to gain more control over the precracking process and to reduce the precracking cost. A feasibility study identified the piezo-electric actuator as an excellent candidate for this purpose.
A dedicated precracking machine for PCCV specimens based on a piezo-electric actuator was developed. The high degree of automation allows full control over the precracking process in agreement with current or future standards. The low power consumption, high precracking frequency, low yield loss, low maintenance and minimum operator intervention significantly reduced the precracking cost.
A second piezo-precracking was installed in a hot-cells and is already providing a reliable service for several years.

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Presenter: Mr SCHUURMANS, Johan (SCK-CEN)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **10** Type: **Oral**

The Development of the Shielded Secondary Electron Microscope at KAERI

Wednesday, September 24, 2014 11:30 AM (30 minutes)

KAERI developed a shielded secondary electron microscope, which was remodeled from the Philips XL-30 model in 1998. The SEM was installed inside a glovebox, which had the shielding wall of 17 cm carbon steel and the confinement wall of hardened glass. Also, the glovebox was connected to the deep under pressure (DUP) line of a HVAC system. The shielded SEM has been applied to fractography of a spent fuel pellet, crud analysis of a PWR cladding, surface inspection of the contact area between grid spring and fuel rod, hydride morphology analysis of a cladding and so on.
Currently, we have developed the quantitative analysis techniques by the WDS-SEM. As a part of the development, we remodeled a sputter coater for hotcell and made a quantitative analysis program for a WDS-SEM including the function of inspecting the beam stability. We have plan to analyze fission products like Xenon and Neodymium inside a spent fuel and dopants like Manganese and Chromium of doped UO2 by the techniques.

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Presenter: Mr KWON, Hyoung-Mun (Korea Atomic Energy Research Institute)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **11** Type: **Oral**

Inpections & Sample Extraction on the MEGAPIE Liquid Lead-Bismuth Spallation Neutron Target in the PSI Hotlab Hotcells

Monday, September 22, 2014 11:00 AM (30 minutes)

MEGAPIE is an experiment aiming at demonstrating the safe operation of a liquid-metal spallation target at a beam power level of 1 MW in the SINQ target station at the PSI. It is an international collaboration of ten partners and is of relevance for accelerator driven reactor systems, in which an accelerator and target provide the neutrons necessary to maintain a fission reaction. The MEGAPIE experiment will be an important ingredient in defining and initiating the next step towards building a target for the accelerator of a dedicated accelerator-driven reactor system (ADS). Inspections of several target parts and sample extraction on parts of the target, including all preparations and handling in the PSI hot cells, began in 2011 and finished end of 2013.
The presentation will show the technical side, prepreparation, preparation and buildup of the necessary infrastructure, sample extraction and disposal at the end of the 2 years work.

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Presenter: KUSTER, Daniel (Paul Scherrer Institut)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **12** Type: **Oral**

POST-IRRADIATION ANNEALING STUDIES OF SMALL-SCALE U-MO MONOLITHIC FUEL SAMPLES

Monday, September 22, 2014 4:30 PM (30 minutes)

Monolithic uranium-molybdenum (U-Mo) has been proposed as one fuel design capable of converting some of the world's highest power research reactors from using high-enriched uranium (HEU) to low enriched uranium (LEU) fuel. One aspect of the fuel development and qualification process is to demonstrate the extent of fission product release from the fuel under anticipated service environments. To obtain this information, a multi-component materials characterization apparatus was designed and placed within a customized hot-cell. Small-scale samples cut from larger, irradiated fuel segments, were subjected to thermogravimetric/differential thermal analysis (TG/DTA) over a specified temperature profile. A controlled atmosphere was maintained during the thermal profile by flowing sweep gas of known composition over the sample and real time fission gas release data was obtain via mass spectrometry of the effluent from the TG/DTA. Additional fission product release data was obtained via chemical analysis of getters and cold traps that were included between the TG/DTA and mass spectrometer to capture species with limited volatility. This paper will discuss features of the apparatus, studies to optimize experimental parameters, and initial measurements to investigate fission product release from small samples. The mechanisms responsible for release of fission gas from irradiated samples will also be discussed.

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Presenter: Dr BURKES, Douglas (Pacific Northwest National Laboratory)

Session Classification: PIE

Contribution ID: **13** Type: **Oral**

Non-destructive examination on spent fuel rods

Monday, September 22, 2014 1:30 PM (30 minutes)

In order to investigate the behaviour of PWR fuel rods, eight fuel rods extracted from reactor of Qinshan NPP(QNPP) were examined at the hot cell facility ofChina Institute of Atomic Energy (CIAE) in Beijing. The maximum burnup was about 40 GWD/TU. This paper presents the results of non-destructive examination. The results included: 1) Status of cladding surface, 2) cladding integrity, 3) distribution of oxide film on the outer surface of claddings, 4) dimensional change on axial and circumferential, 5) distribution of fission products in the fuel column, 6) defects, uniformity and structural integrity of the fuel and cladding. The obtained data could be used to evaluate the security, reliability and nuclear fuel performance, and for PWR fuel improvement.

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Presenter: Mr WANG, Huacai (China Institute of Atomic Energy)

Session Classification: PIE

Track Classification: PIE

Contribution ID: **16** Type: **Oral**

REPLACEMENT OF A HEAVY MANIPULATOR IN A HOT CELL

Tuesday, September 23, 2014 10:30 AM (30 minutes)

In 2009 CEA decided to replace the Heavy Manipulator (HM) of Irradiated fuel elements Cell of the French nuclear power plant PHENIX. The heavy manipulator broke down in 2010 after 40 years of operation. Nearly all means of remote operations in this cell were lost. This HM failure leads to stop the maintenance of other equipment in the hot cell. The replacement program was implemented and achieved in 2012.
This program consisted of the following:
- Analysis of the existing heavy manipulator's dismantling,
- Functional analysis for a new heavy manipulator,
- Design of new manipulators,
- Manufacturing, testing and introduction of new heavy manipulators
This operation was conducted by the Commissariat à l'Energie Atomique (CEA), Marcoule center.

Summary

REPLACEMENT OF A HEAVY MANIPULATOR IN A HOT CELL

F. DOMINJON, H. DUPORT, F. LAURENT, P. BRUGUIER

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In 2009 CEA decided to replace the Heavy Manipulator (HM) of Irradiated fuel elements Cell of the French nuclear power plant PHENIX. The heavy manipulator broke down in 2010 after 40 years of operation. Nearly all means of remote operations in this cell were lost. This HM failure leads to stop the maintenance of other equipment in the hot cell. The replacement program was implemented and achieved in 2012.
This program consisted of the following:
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- Functional analysis for a new heavy manipulator,
- Design of new manipulators,
- Manufacturing, testing and introduction of new heavy manipulators
This operation was conducted by the Commissariat à l'Energie Atomique (CEA), Marcoule center.

1. Introduction : The existing heavy manipulator of the Cell is a semi gantry with a bracket and an arm. It moves from north to south on railways. It had more and more difficulties to move. The hot cell is only at half of its production objective (1700 fuel or dummy elements already done, the same has to be done). So in 2009 it was decided to change the existing HM. The arm (shoulder) of the heavy manipulator finally broke down in 2010.

2. Analysis of the existing heavy manipulator's dismantling The existing heavy manipulator is mechanically and electrically linked to the wall and to the rails of translation. It was introduced at the end of the cell building without providing possibilities for removal or remote intervention (except for the bracket and arm). It was decided to leave it in the middle of the hot cell temporarily. The hot cell is 14 meters long.

3. Functional analysis for new heavy manipulators Two zones were identified:

4. The bottom part with recurrent uses of the manipulator,
5. The top part with exceptional uses. It was decided to manufacture two heavy manipulators. Each manipulator using an existing arm adapted on a specific trolley was supposed to lift 200 Kg. The lower manipulator is permanently in the cell, uses the existing railways, has a parallelogram to reach the requested zone, can be removed from the cell for repair, is carried out from north to south of the existing heavy manipulator with the lifting unit. It is used for emergency exit of the top manipulator. The top manipulator is introduced in the cell on demand, is put on the crane frame and linked to the crane trolley (right or left). The motions are managed by the crane.
6. Design of new manipulators The new manipulators had to get in the hot cell from the maintenance cell through a square hatch of 1.5 meter large in order to get in for implementation and to get out for maintenance. Only the crane can access the implementation zone of the bottom manipulator. The put down of manipulator and plug in of power was done by the crane and the manipulator itself finished its establishment. It was linked to the railways by anti-tilting equipment to prevent a seismic hazard. The movements of manipulators are electrically motorized in order to limit oil in the cell (to prevent criticality hazard). Electrical power, instrumentation and control are the same for both manipulators.
7. Manufacturing, testing and introduction of new heavy manipulators The new manipulators had to be adapted to a rather undefined environment. The electrical distribution represented an important difficulty. The first implementation was done by the crane, then the manipulator was connected and prepared itself its zone (better implementation of the power supply, cleaning of the zone in order to put on the cable chain, put on the cable chain, …). The top manipulator was supplied by a cable from the bottom of the cell.

The manufacturing of the new manipulators was carried out between January 2011 and March 2012. The new manipulators were set up from March to June 2012.

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Presenter: Mr DOMINJON, FRANCK (CEA)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **17** Type: **Oral**

Online measurement of fission products release during nuclear fuel annealing : A mass spectrometry approach

Monday, September 22, 2014 2:30 PM (30 minutes)

In order to increase fuel rod performance, the basic mechanisms that promote gas (i.e. He, H2, Kr and Xe) release from irradiated nuclear fuels must be studied. In this context, the CEA fuel study department at Cadarache decided to improve its experimental facility devoted to fuel behaviour under thermal transient by modifying the existing annealing device, called MERARG-II, to extend the studies of gamma emitter fission gases to all gases (including Helium and hydrogen) with a complete isotopic distribution capability.

As a consequence, a joint research program between Aix Marseille University and CEA Cadarache was built in order to develop a mass spectrometer apparatus with a sampling device adapted to MERAG-II sweeping line for monitoring gaseous fission products at very low threshold levels and response times.

A Residual Gas Analyser (RGA) mass spectrometer type is used as a process-monitoring device. The mass analyser is thus enclosed in a small vacuum chamber. The RGA is equipped with a two-stage pressure converter sampling-device to adapt the pressure drop between the vacuum chamber and MERARG-II line at 1.2 bar. The sampling device also insures both no mass-segregation and the fastest transportation times (about 1 s) of neutral particles toward the ion source of the mass analyser. The sampling device operates according to two modes: (a) online measurement (for release kinetic) and (b) a static mode to reproduce the delayed measurement of capacities containing the total quantity of released gases.

After having described briefly the MERARG-II facility, the paper deals with two main axes:
• present the modelling of gas sampling inlet device and its performance. In particular, we will focus on the balance equations at the steady state for gas throughput to estimate pressures and flows for dimensioning the sampling device and the pumping system.
• give a concise review of the main aspects of the qualification/calibration phase of the RGA type analyser. We will then discuss results recorded over three mass ranges 1-10 u, 80-90 u and 120-140 u in the two classical mode of MERARG-II, i.e. on-line and off-line measurements. Then, we will detail the corresponding detection limitation of this RGA (less than 1 ppm).

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Presenter: Ms GUIGUES, Elodie (LISA)

Session Classification: PIE

Track Classification: PIE

Contribution ID: **18** Type: **Poster**

DESIGN CONSIDERATIONS FOR PIECE (PIE Cells at ESS)

The European Spallation Source (ESS) will deliver the world's highest flux of slow neutron beams for the basic and applied researches investigating the molecular building blocks of matter. The primary neutrons will be produced by bombarding a high-energy proton beam into the solid tungsten target. As the target itself and the surrounding moderator reflector system will be exposed to a large flux of protons and neutrons, the materials used for the engineering of the target-moderator-reflector (TMR) system will be subject to radiation damage. Among others, another system of concern from the radiation damage standpoint is the proton beam window (PBW) that is subject to concentrated proton beam irradiation. For the design and lifetime estimation of the components, it is therefore important to understand the characteristics and behaviour of the engineering materials that are exposed to proton and neutron fluxes.

Unfortunately, there is a scarcity of engineering data for the properties of high-energy hadron irradiated materials. The uncertainty in the radiation damage effects on materials necessitates a high level of conservatism in the component design lifetimes and operation of the ESS target station, which will drive the operational costs upward.

A feasibility study of equipping a PIE (Post Irradiation Examination) facility infrastructure at ESS in the post-construction phase of the project is under consideration. In this paper, the scope, the design requirements and the top-level system architecture of the PIECE (PIE Cells at ESS) facility are presented. The proposed PIECE facility aims at fulfilling the following three objectives: to measure the mechanical properties of irradiated target station structural components for the purpose of estimating component lifetimes, to study new candidate materials for the target station components applications for longer lifetime and higher reliability, and to perform fundamental researches on the irradiated materials in the framework of international collaboration. The presented study provides necessary inputs for currently on-going target station design activities such that the PIECE facility can be readily incorporated into the ESS infrastructure in the post-construction or in the operation phase of the project. Vice versa, the currently base-lined target station design provides the constraints on the scope of the PIECE facility. The roadmap for developing the PIECE plan from the current feasibility study towards the post-construction phase project with dedicated resources is presented.

Summary

A feasibility study of equipping a PIE (Post Irradiation Examination) facility infrastructure at ESS in the post-construction phase of the project is under consideration. In this paper, the scope, the design requirements and the top-level system architecture of the PIECE (PIE Cells at ESS) facility are presented.

Primary author: Dr LEE, Yongjoong (ESS)

Presenter: Dr LEE, Yongjoong (ESS)

Contribution ID: **19** Type: **Oral**

GASR Volume Determination and Characterization

Monday, September 22, 2014 4:00 PM (30 minutes)

The Gas Assay, Sample and Recharge (GASR) system at the Hot Fuel Examination Facility (HFEF) at Idaho National Laboratory is used to puncture fuel elements, collect gas samples for analysis, and determine the free volume in a fuel element. This process is used to sample and determine fission gas release from irradiated fuel experiments. Accurate knowledge of the GASR system component volumes is necessary for calculating fuel element volumes. Following a recent GASR system repair and new auxiliary volume fabrication, the system volume determination was performed. Results of the system volume determination and characterization of the overall system uncertainty will be presented.

Primary author: Dr CHICHESTER, Heather (Idaho National Laboratory)

Co-author: Mr SELL, Dave (Idaho National Laboratory)

Presenter: Dr CHICHESTER, Heather (Idaho National Laboratory)

Session Classification: PIE

Contribution ID: **20** Type: **Poster**

Development of detection technique of corrosion and defect by X-ray computed tomography

The non-destructive detection technique of corrosion and defect on the irradiated fuel assembly has been developed in Japan Atomic Energy Agency (JAEA). The X-ray computed tomography (CT) images of the corrosion layers (from 0 mm to 0.7 mm thickness) and the cracks (from 0.1 mm to 0.8 mm width) on a cladding tube were taken. The corrosion layers of more than 0.35 mm thickness and the cracks of more than 0.1 mm width were observed on the X-ray CT images.

Primary author: Mr AKIHIRO, ISHIMI (Japan Atomic Energy Agency)

Co-authors: Mr KOZO, Katsuyama (Japan Atomic Energy Agency); Mr HIROFUMI, Nakamura (Japan Atomic Energy Agency)

Presenter: Mr AKIHIRO, ISHIMI (Japan Atomic Energy Agency)

Contribution ID: **21** Type: **Poster**

Deformation Behavior of an Irradiated Spacer Grid for PWR Fuel Assembly

The mechanical properties of a space grid of a fuel assembly are of great importance for fuel operation reliability in extended fuel burnup and duration of fuel life. A spacer grid with inner and outer straps has cell spring and dimples, which are in contact with the fuel rod. The spacer grids supporting the fuel rods absorb vibration impacts due to the reactor coolant flow, and grid spring force decreases under irradiation. This reduction of contact force might cause grid-to-rod fretting wear. The fretting failure of the fuel rod is one of the recent significant issues in the nuclear industry from an economical as well as a safety concern. Thus, it is important to understand the characteristics of cell spring behavior and the change in size of grid cells for an irradiated spacer grid. To evaluate the fretting wear performance of an irradiated spacer grid, hot cell tests were carried out at IMEF of KAERI. Hot cell examinations include spring stiffness measurement and dimensional measurement for the irradiated spacer grid. The stiffness of cell springs was dependent on the measurement positions, leading to significant load variations. The change of cell sizes was dependent on the direction of the spacer grids, leading to significant gap variations. It was found that the change in size of the cell springs due to irradiation-induced stress relaxation and creep during the fuel residency in the reactor core affect the contact behavior between the fuel rod and the cell spring.

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Presenter: Dr JIN, Young Gwan (KAERI, 989-111 Daedeok-daero, Yuseong-gu, Daejeon, 305-353, Republic of Korea)

Contribution ID: **22** Type: **Oral**

MINOR ACTINIDE BEARING BLANKET MANUFACTURING PRESS

Tuesday, September 23, 2014 8:30 AM (30 minutes)

This study concerns the Advanced Processes of Conversion and Manufacturing of fuels for transmutation. One of the fuel manufacturing processes arises from the conventional process of the powder metallurgy industry and enables pellet shaping in dies and sintering. The shaping of the MABB pellets is currently done manually in hot cells. In this study, automation for this manufacturing and a better control of the shaping parameters were tested in order to prepare the way for a new automatic nuclear press. Collaboration has been set up between the CEA (ATOMIC ENERGY COMMISSION) and the CHAMPALLEALCEN Company for the construction of the new press. The minimization of criticality risks is an important goal for the manufacturing of the AMBB pellets, and is the main reason why the press is being built to function without oil and is completely electromechanical. It's a uni-axial, automatic press, mono-punch, single effect apparatus with a displacement-piloted die. Its capacity is 10 tones, the maximum height is limited to 1200 mm and the production rate is 1 to 5 cylindrical annular pellets per minute. Installing the apparatus in a hot cell for nuclear fuel production required simulation studies which were carried out using the STUDIO MAX 3D software. The objective was to validate the modular units' ability to be assembled, dismantled and maintained by remote handling techniques, using LACALHENE-MT120 equipment. The thirty separate units making up the press had to go through a 240 mm diameter air-lock to enter the hot cell. To be sure the remote handling scenarios were appropriate, virtual reality simulation studies were carried out, taking into account force feedback and the inter-connectability of the different units. In parallel, MERCURAD and MCNP5 software checked that the press components' radiological dimensioning would ensure its radiation resistance during operation in a hostile environment. A mock-up simulating the future hot cell and equipped with the MT120 was built in the CEA/Marcoule HERA facility technological platform in order to physically test press unit assembly by remote handling, and the apparatus operations. This press adapted to nuclear conditions has a patent pending.

Primary author: Mr BAYLE, Jean Philippe (CEA)

Presenter: Mr BAYLE, Jean Philippe (CEA)

Session Classification: Fuel Production

Track Classification: Fuel Production Facilities

Contribution ID: **23** Type: **Oral**

A NOVEL CONCEPT FOR THE ESS TARGET STATION HOT CELLS

Tuesday, September 23, 2014 2:00 PM (30 minutes)

The European Spallation Source (ESS), Lund, Sweden will be a 5MW long pulsed neutron research facility with planned commissioning in 2019. A connected hot cell facility will deal with the large, heavy and complex radioactive components as they reach their lifetime limit after service in the neutron research facility. The hot cell will be unique in its design for this specific reason. A special precondition for ESS, being a green field facility, is that there is neither a heritage nor any logistical constraints, which is often the case for existing facilities.

The ESS will be operational for around 45 years once commissioned and the hot cell facility will be operative during the complete operational phase of ESS as well as being an important part of the decommissioning of ESS. This requires the design to have a very high degree of flexibility in order to adapt to changes of target station component designs as well as changes of the functional requirements for the hot cells themselves.

As one alternative to the baseline hot cell design, the novel design concept presented in this paper incorporates the above mentioned complexities as well as the ALARA concept, BAT (best available technique), operator ergonomics and also includes a high level of modularity which in turn facilitates future updates and technologies as well as increases redundancy and availability. In contrasts to the baseline design, the novel design relies heavily on cameras and robotic systems in lieu of traditional through-the-wall telemanipulators and windows.

Primary author: Mr GÖHRAN, Magnus (Work Package Manager)

Presenter: Mr GÖHRAN, Magnus (Work Package Manager)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **24** Type: **Oral**

THE ESS IRRADIATED TARGET WHEEL HOT CELL OPERATIONS FOR HANDLING, DISMANTLING, SEPARATION AND PREPARATION FOR FINAL DISPOSAL

Tuesday, September 23, 2014 2:30 PM (30 minutes)

The European Spallation Source (ESS), Lund, Sweden will be a 5MW long pulsed neutron spallation research facility with planned commission 2019. The ESS hot cell facility will be equipped with several systems and functions, where one of the functions shall cover the complete dismantling, separation and preparation for final disposal of the irradiated tungsten target wheel. The target wheel has a diameter of 2,5 m and consists of a tungsten core which constitutes the spallation material. A stainless steel shroud, including slab supports encloses the tungsten. The shroud is connected to a shaft via a central hub. The total height of the assembly is 5,3 m and the total weight is 14,5 tons.

The process of safe handling, dismantling, separation and preparation for disposal of the target wheel parts, needs a set of functional prerequisites such as; lifting, fixation, cutting devices, camera systems etc. The dismantling procedure needs to be well predefined to enable optimized packaging in relation to volume, materials, weight, radiation level, etc. A transport cask system adapted to the specific needs of ESS with regard to compliance to regulations in terms of handling of long-lived low and intermediate level waste is also needed to fulfil the process.

This paper will describe the specific ESS hot cell facility function, concerning the process: from separating the parts of an irradiated tungsten target wheel to the preparation for the off-site transportation.

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Presenter: Mr ÅSTRÖM, Lennart (Fagerström Industrikonsult AB)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **26** Type: **Oral**

The new VTT Centre for Nuclear Safety

Wednesday, September 24, 2014 8:30 AM (30 minutes)

VTT has been hosting the Finnish national hot laboratory infrastructure since the first nuclear power plants were constructed in Finland in the 1970's. Historically the principle radioactive materials handling has been for the testing of reactor pressure vessel steels, but over time the activities have broadened to outgrow both the capacity and capabilities of the existing facilities. As such, a decision was made in 2011 to build a whole new facility, with the additional goal of gathering most of the VTT Nuclear Safety research personnel currently scattered around the Otaniemi campus, into a single, compact facility called the VTT Centre for Nuclear Safety (CNS). The CNS is comprised of an office wing and a laboratory wing, and the laboratory wing is comprised of C-, B- and A-class radiological laboratories. Although the site is atop an underground parking garage, special attention was paid to optimizing the basement space, to exploit the natural gamma shielding offered by the granite. The VTT research staff has been integral in the design process, in order to assure that the laboratories meet the current and foreseen future needs. The C-class laboratories include radiochemistry laboratories, cleanroom facilities for trace element analysis, nuclear waste management research, and C-laboratory support facilities like an electronics shop and utensil cleaning and storage. The B-class radiological laboratories contain the controlled entrance area (also used for accessing the A-laboratory), an iodine filter laboratory, radiochemistry laboratory with nuclear material handling allocation, and a mechanicals workshop. Microscopy facilities include a TEM on the B-laboratory side, and a SEM and light microscopy facilities in the A-class laboratory. The A-laboratory spans a part of the main floor shared with the B-laboratory, as well as the basement facilities. On the main floor it includes the hot cell high bay and the pilot hall, equipped with a 10 ton capacity bridge crane. The basement facilities are mainly for storage and handling of radioactive sources, specimens and waste, but include a liquid waste handling room, autoclave room and double hot cell. Transportation of radioactive materials into and out of the laboratory occurs by way of a separate, covered truck park, through an airlock into the basement. Transfer of radioactive materials within the laboratory is possible with a dedicated facility cask handled by the bridge crane and/or a cart. Overall the design process carried out over the last two years has yielded very satisfactory results and the facilities can be expected to serve the purposes well.

Primary author: Dr KARLSEN, Wade (VTT Centre for Nuclear Safety)

Presenter: Dr KARLSEN, Wade (VTT Centre for Nuclear Safety)

Session Classification: Administrativ Tool

Track Classification: Administration Tools

Contribution ID: **28** Type: **Oral**

RESUMPTION OF OPERATION OF THE PHENIX HOT CELLS: THE SAWING LINE REFURBISHMENT

Tuesday, September 23, 2014 11:00 AM (30 minutes)

The Phenix Irradiated Elements Cell was started up in 1973 and the Annex Cell in 1981. They are dedicated to the dismantling of the spent fuel sub-assemblies, to the post-irradiated nondestructive examinations on the sub-assemblies, the irradiated capsules and the pins, and, in the early stage of operation to the refabrication of new experimental capsules with irradiated pins.

The mechanical process related to the sub-assemblies dismantling line were put in the Annex Cell. They were chosen and designed to remove the pins from the stainless steel hexagonal wrapper in such a way that the mechanical stresses due to the high cumulative dose rate could be released without any risks for the integrity of the stainless steel cladding, the first barrier. The first step of this process consists in sawing the sub-assembly simultaneously in three or four parts depending on its nature, fissile fuel or breeder : the spike, the fuel (or breeder) pins bundle, the upper axial blancket pins bundle (for a fuel sub-assembly) and the upper neutron shielding with the handling head. Until recently, the bench was equipped with two or three retail standard fully hydraulic hacksaws from KASTO®. Only the electric and hydraulic connectors and the base were replaced to be compatible with the hot cell environnement. After more than 35 years of operation and despite a maintenance program reinforced during the last decade these saws were not allowing to have enough confidence and were bringing no more guaranties about the safety of the cutting. Furthermore, the decontamination procedures necessary before a manual maintenance done in a low level activity workshop had become more and more complex due to the decontamination products short-listed by the Marcoule effluents treatment facility that have been not enough efficient to clean the aggregates of irradiated grease and activated stainless steel chips.

For both reasons it was decided in the beginning of 2008 to start the refurbishment of the sawing bench. The main specifications of the new design were : the compatibilty to the unchanged fixing system constituted of two centering pins and a locking pin for each sawing position, the volume of the new saw, a brick building principle to facilitate the decontamination of the only broken part of the saw, a maximum of standard spare parts available at retail, the remote handling of the valves of the hydraulic group by telemanipulator, a limited quantity of hydrolic fluid according to the criticality rules of the cell, a higher reliablity of the cutting guidance, and a performance of more than 1000 cuts without maintenance. After two years of developpement and several reliable and endurance tests five saws were delivered in Phenix on April 2013. After several inactive dry tests the first three saws were put in the cell on December 2013. After the qualification testing the new sawing line was used to dismantle an experimental sub-assembly. During this operation many problems had been appeared. In the face of this unsatisfactory feedback it was decided to implement a program of modifications.

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Co-authors: Mr MASSON, Marc (CEA); Mr BRUGUIER, Philippe (CEA)

Presenters: Dr PAUL, Jean-Luc (CEA); Mr BRUGUIER, Philippe (CEA)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **29** Type: **Oral**

Development of irradiated specimens transport system within the two semi-hot cells refurbishment project

Wednesday, September 24, 2014 3:30 PM (30 minutes)

The paper presents the procedure and current status of refurbishment project of two semi-hot cells at UJV Rez, a. s. with linked project focused on the design and construction of new transport system for irradiated specimens from semi-hot cell No. 1 to the refurbished semi-hot cell no. 9. Reconstruction was carried out at the Mechanical Testing Department of Integrity and Technical Engineering Division. The whole procedure from beginning of the project (feasibility study, work schedule) to the current status of refurbishment is depicted in the paper.

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Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **30** Type: **Oral**

Process is King-Selecting the right Design for new HOTCELLS

Tuesday, September 23, 2014 9:00 AM (30 minutes)

It is important to undertake any hot cell and containment project with a clear statement of intent. This statement of intent is sometimes called a Functional Requirement Specification or FRS.

It is the FRS that should be used as the basis for design and the process from which all other items are developed.

The paper will describe the engineering process employed by Aquila Nuclear Engineering in producing fit for purpose HOTCELLS designs using the Aquila Influence Diagram (AID)

Summary

The Aquila team of Engineers have designed, manufactured and installed over 100 bespoke hot cells within the past 15 years. We have learnt over these years to listen to our Clients needs in terms of process and functionality before embarking on hot cell proposals which may be ill founded and raise false expectations.

Process is King is our motto and it is from the processes inside the cells that all design criteria start to fall into place. We use the Aquila Influence Diagram (AID) to make sure we ask our clients the right questions and engineer the answers into the scheme design.

Primary author: Mr BARKER, David (Aquila Nuclear Engineering Ltd)

Presenter: Mr BARKER, David (Aquila Nuclear Engineering Ltd)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **31** Type: **Oral**

New devices designed and used to perform dissolutions in Atalante Hot Cells : Application to the oxide fuel dissolution

Wednesday, September 24, 2014 11:00 AM (30 minutes)

In the frame of the back-end of the nuclear spent fuel, the shielded cells of ATALANTE facility which are called C11-C12, are dedicated to R&D studies on the high-activity chemistry of the dissolution of spent nuclear fuel and more generally to the issues of the first step of the PUREX process. The experimental programs carried out since the hot commissioning in 1999 have required permanent evolutions in the shielded line : new specific apparatus were designed to improve the dissolution step and ultimately the comprehension of this complex chemistry involving acidic solutions, newly formed or undissolved solids, and off-gases.

This equipment permits among other things studies on the following steps:

- Mechanical treatment before the dissolution of irradiated targets,
- Dissolution of the dissolution residues using strong media like fluorhydric acid or ozone,
- Off-gas determination by oxidation for a quantitative trapping.

This paper presents the technical development of the new equipment implemented in the C11/C12 shielded cells and along with the first results of the experiments on fuel dissolution studies.

Primary author: FERLAY, GILLES (CEA MARCOULE)

Presenter: FERLAY, GILLES (CEA MARCOULE)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **32** Type: **Oral**

UK fuel cycle R&D in Advanced Nuclear Fuels

Monday, September 22, 2014 11:30 AM (30 minutes)

The depth and breadth of ceramic fuels manufacture R&D capability within the UK is based on decades of support to UK industry programmes together with involvement in international programmes. With the closure of the final UK programme in this area these skills are likely to diminish without other programmes being implemented to sustain them.
In response to concerns relating to the UK's Nuclear R&D capability the UK Government has published an R&D Roadmap [ ] (Nuclear Energy Research and Development Roadmap: Future Pathways) which sets out a vision for nuclear research and development and the research outcomes that would be needed to support future energy policy decisions. It also makes the case that Government will need to take action to maintain an agile and flexible R&D capability to ensure that informed decisions can be made.
The Government's R&D roadmap cites research objectives for the short and long term including; protecting and developing nuclear fission skills and knowledge, development of organisational infrastructure and re-engagement with international collaborative programmes.
Part of the Government's long term vision is to equip the UK to supply the fuel needs for Generation III+, Generation IV and Small Modular Reactor reactors globally. Part of this vision includes the facilities of a newly established Nuclear Fuel Centre of Excellence (NFCE), for housing this fuel R&D equipment. The NFCE is a novel concept which involves the establishment of a world class capability within existing facilities operated by the UK's National Nuclear Laboratory and the University of Manchester. These facilities will need to handle quantities of active materials including alpha active materials and house the required material performance testing and analysis equipment.
To attain a world-leading fuel manufacturing status will require fundamental research into fuel material performance and new and improved fabrication technology, and this research will need to be conducted by subject matter experts who have access to world-leading facilities. The establishment of a UK Nuclear Fuel Centre of Excellence would provide this, and see industry, NNL and academia engage in national and international collaborative research in advanced fuel manufacturing technology. The NFCE will be open to international partners, offering world-leading capability and facilities in advanced fuel fabrication R&D, complementing international facilities such as the Halden and Jules Horowitz Test Reactors.

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Session Classification: Fuel Production

Track Classification: Fuel Production Facilities

Contribution ID: **33** Type: **Oral**

Design and Construction of New Hot Cells and Micro-Machining/EDM Facilities at ANSTO

Wednesday, September 24, 2014 2:00 PM (30 minutes)

The Australian Nuclear Science and Technology Organisation (ANSTO) has operated research reactors since the late 1950s. The OPAL reactor was commissioned in 2007 and is used as a source of neutrons for medicine, provision of beams for research, silicon irradiation, NAA/DNAA and the effects of neutron irradiation on structural materials. While ANSTO has extensive hot cell facilities on site these are mainly used for the production of medical isotopes or reactor maintenance activities. Additional capability was required for the examination and testing of material from the OPAL materials surveillance program and from research programs aimed at monitoring changes in structural materials for advanced nuclear power generation systems. The purpose of the surveillance program is to monitor changes in the properties of OPAL's core materials; principally zirconium and aluminium alloys, and to ensure that the changes are as expected.
ANSTO undertook an extensive review of hot cell facilities internationally and put out a tender for construction. This was awarded to Robatel Industries of France. An additional and essential part of the facility was the capability to undertake machining of active materials, in order to convert them into suitable test specimens. Several options were explored with the final contract being awarded to Viteris Technologies for the development of their micro-machining/electro discharge machining (EDM) device for hot cell operation.
This paper presents the overall design of the facility and a detailed examination of the micro-machining/EDM centre and describes the actions undertaken to convert a selection of retired reactor components into test samples such as "dog-bone" tensile specimens, compact tension fracture specimens and small punch and TEM discs. The activity of the samples will be very high, with samples of zirconium alloy irradiated to a fluence of up to 4 x 1022 n/cm2 (E > 1 MeV) being prepared (the cells are designed to contain up to ~200 GBq of Co60 each).

Summary

ANSTO is Australia's national nuclear research organisation. It operates one research reactor, OPAL, and has recently constructed new hot cells for undertaking examination and testing of radioactive materials. A new in-cell micro-machining/EDM device has been designed and constructed by Viteris Technologies to provide the means of sectioning active material from the reactor or research programs to provide small test samples.

Primary author: Mr HARRISON, Robert (Australian Nuclear Science and Technology Organisation)

Co-authors: Dr BAMBERG, Eberhard (Viteris Technologies); Dr OBBARD, Edward (Australian Nuclear Science and Technology Organisation); Mr TOPPLER, Karl (Australian Nuclear Science and Technology Organisation); Mr THOROGOOD, Kevin (Australian Nuclear Science and Technology Organisation)

Presenters: Dr BAMBERG, Eberhard (Viteris Technologies); Dr OBBARD, Edward (Australian Nu-

clear Science and Technology Organisation)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **34** Type: **Oral**

CONTINUATION OF CONSTRUCTION OF HOT CELL FACILITY IN CVR

Wednesday, September 24, 2014 2:30 PM (30 minutes)

Paper presents the continuation of construction of hot cell facility within the project SUSEN (Sustainable Energy) at CVR (Research centre Rez) [1]. The cells will be used for preparation and testing of irradiated structural materials. The project uses existing building converted for the purpose of placement of new hot cells. New design is used – heavy shielding with airtight steel box.
Paper is focus on constructional difficulties that come out from new layout of hot cells. Constructional solution of these difficulties will be discussed, namely airtight steel box, material transfer device, temporary sample storage, pre-chamber and design of semi-hot cell. All solution must be safe, functional, stable for long time, with low maintenance and all automatic manipulation replaceable with manual force.
The project SUSEN is fully funded by the European Union. Most components must be purchased on the basis of competitive tendering or competitive dialogue.

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Presenter: Dr SRBA, Ondrej (Centrum vyzkumu Rez)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **37** Type: **Oral**

Study on Poolside Inspection Technology for Pressurized Water Reactor Fuel Assembly

Monday, September 22, 2014 5:00 PM (30 minutes)

The poolside inspection technology is introduced through the underwater inspection of pressurized water reactor fuel assembly and each inspection method is discussed and analyzed. This technology mainly including visual testing, dimension measurement and eddy oxide measurement. The results show that the surface state, irradiation growth, and oxide layer thickness of pressurized water reactor fuel assembly have been achieved accurate and reliable from the poolside inspection technology. And the necessary basis is provided for the irradiation stability and integrity of pressurized water reactor fuel assembly.

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Presenter: Mr REN, Liang (Nuclear Power Institute of China)

Session Classification: PIE

Track Classification: PIE

Contribution ID: **40** Type: **not specified**

Summary and final remarks

Wednesday, September 24, 2014 4:30 PM (30 minutes)

Presenter: Dr GAVILLET, Didier (Paul Scherrer Institut)

Session Classification: Summary Session

Contribution ID: **41** Type: **Oral**

DEVELOPMENT OF LASER PUNCTURING AND FISSION GAS ANALYSIS SYSTEM FOR FUEL ROD IN HOTCELL

Tuesday, September 23, 2014 11:30 AM (30 minutes)

To measure a very small fission gas amount in fuel rod, laser puncturing was available to make hole on the surface of a cladding tube instead of steel needle puncturing due to reduction of chamber volume. After puncturing, pressure difference was measured by a fine pressure gauge. A small chamber and a quartz tube were used to measure small gas amount and to penetrate laser shot from outside. The pressure and the vacuum ranges are 1~1,000 torr and ~10-6 torr, respectively. This system can be measured at least 2cc at room temperature. After measuring gas pressure, fission gases were transferred to QMS(Quadruple Mass Spectrometer) in high vacuum state which is installed in glove box to analyze gas contents(up to 200 amu). QMS was useful to measure xenon, krypton and helium. It must be calibrated with several reference gases(He+Xe+Kr). Measurement of total amounts and quantitative contents of fission gases in fuel rod was carried out at one time. U-Zr metallic fuel rods were used to measure total gas amounts and to analyze contents of helium, xenon and krypton.

Primary author: Dr KIM, Heemoon (Korea Atomic Energy Research Institute)

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Presenter: Mr HEO, Ki-Soo (Korea Atomic Energy Research Institute)

Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **42** Type: **Oral**

Implementation, in JHR Project Hot Cells, of recent requirements of French Nuclear Safety Authority (ASN) and experimental need, and also experience gained in CEA nuclear facilities.

Wednesday, September 24, 2014 10:00 AM (30 minutes)

The general purpose of this paper is to present the implementation, in the Jules Horowitz Reactor Project (JHR) hot cells, of most recent requirements of French Nuclear Safety Authority (ASN) and Experimental needs, with taking into account of experience of hot cells use, gained in CEA nuclear facilities.

The Jules Horowitz Reactor is the new CEA material and fuel testing reactor. This facility includes hot cells, mostly for irradiated components management and Non Destructive Examinations (NDE). These cells are currently being mounted on site.
Several topics will be presented:
• Safety requirements of French Nuclear Safety Authority (ASN) and design consequences : containment, fire protection, seismic analysis, etc.
• Experimental needs and associated NDE equipment,
• General layout of JHR hot cells and foreseen equipment.

Primary author: MARTIN-VIGNERTE, sylvain (CEA Cadarache. DPIE/RJH)

Presenter: MARTIN-VIGNERTE, sylvain (CEA Cadarache. DPIE/RJH)

Session Classification: Administrativ Tool

Track Classification: Administration Tools

Contribution ID: **43** Type: **Oral**

IR&D funding within the UKs NNL: an overview and IR&D case study

Monday, September 22, 2014 9:50 AM (30 minutes)

Internally funded research and development (IR&D) is an integral part of the UK's National Nuclear Laboratory (NNL) strategy. Over the past few decades, the UK has seen a decreasing trend in funding nuclear research, alongside a community at risk of losing leading researchers within 5-10 years and limited availability of facilities to support those researchers wishing to work in this field. Only recently has this begun to change, although a steady increase between 2000-2009 still leaves current funding levels at only 7% of what they were in 1980.
A significant (50%) increase of NNLs internal research budget emphasises this recent change of attitude within the UK. Internal research supports development and enhancement of NNLs technical reputation through new or novel projects, a key part of which is progression of junior technical staff. In addition, IR&D projects often provide funding for experts to interact with national and international collaborators, for example for development of joint research proposals which are actively encouraged through this programme.
A recent IR&D project, the aim of which was to carry out a feasibility study towards re-instating active fumehood DSC techniques on reactor irradiated materials, will be described. An irradiated austenitic steel (irradiated @ ~500C for ~60,000hrs to 5dpa in CO2) was studied as part of this programme, the initial results of which are described here, in addition to the assessment of the impact of research.

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Session Classification: Opening

Contribution ID: **44** Type: **Oral**

The CEA Nano-characterization platform for irradiated materials of the LECI Nuclear Material Department

Monday, September 22, 2014 3:30 PM (30 minutes)

Introduction

The Nuclear Material Department (DMN) of CEA Saclay is invested in a new nano-characterization platform for irradiation effects analysis. It is composed of a nuclearized Atom Probe Tomography (APT), a Transmission Electron Microscope (TEM), a high resolution Scanning Electron Microscope (SEM) and a Focused Ion Beam (FIB) microscopes coupled with a SEM column.

Infrastructure

The goal of this platform is to investigate the irradiation effect on materials from the micron to the atomic scale which require safe and accuracy sample preparation method. This role is performed with the FIB/SEM to prepare the smallest volume of material required for analysis and to limit its activity. This equipment will perform sampling in specific areas of interest (grain boundaries, crack areas, etc) on any kind of materials (ceramic, metal, oxide) after neutronic irradiation and/or mechanical treatment. Moreover it will perform 3D tomography analysis of the morphology and crystalline structure with a high resolution field emission gun associated to SE, BSE, SESI and EBSD detectors.
To ensure containment of the radioactive sputtered material and to protect equipment and personal of radioactivity the FIB/SEM is connected to a sealed gloves box and both will be located in a first hot cell shielded with 150 mm lead. A door DPTE type system separate FIB chamber to the gloves box, to allow the maintenance of the equipment inside the cell. A second hot cell is in contact with the first one. It will be used to receive samples from the transfer area to clean, prepare and store them before their introduction in the first cell through a sealed tunnel.
The transfer of the FIB holder with finals TEM and APT samples is provided by a sealed container which will be safely connected in the front of the cell via a door DPTE type. Another gloves box will be designed to receive this container and to transfer the final samples from the FIB holder to dedicated TEM or APT holders. Moreover this box will be used to store samples in clean condition and to control the lack of dust spread on finals samples before they exit from the gloves box. This box is in project as the nuclearisation of the APT until the end of 2015. The APT is used since April 2013 to investigate the composition of cold nuclear materials and to understand the atomic organization in ODS steels, aluminium alloys, zirconium alloys, etc.

Conclusion
Thanks to this new platform composed of the most powerful techniques for nano-analysis, the CEA will access to new information on irradiated materials as atomic diffusion, structural and morphological evolution from the micron to the atomic scale. This nano-characterization platform will be operational in late 2015 and the first analysis on irradiated materials are expected early 2016.

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Session Classification: PIE

Track Classification: PIE

Contribution ID: **45** Type: **Oral**

Shield Plug-Mounted Hot Cell Manipulator System

Tuesday, September 23, 2014 10:00 AM (30 minutes)

PaR Systems has been providing remotely-controlled manipulator systems for use in hot cells since 1961. These systems traditionally consist of a bridge which traverses crane rails on the inside of the cell walls; a carriage that traverses rails on the bridge; a telescoping mast that provides vertical travel; and an electro-mechanical manipulator. Manipulators are generally 5-7 axes and are supplied with remotely interchangeable grippers.
These manipulator systems are installed as the cell is being constructed prior to the cell "going hot". They undergo a full range of testing and maintenance demonstrations to ensure the machinery is fully functional and maintenance/repair operations are understood by personnel. Some of these systems that were installed and commissioned in the 1960's and 1970's are reaching the end of their useful life and need to be partially or fully replaced.
PaR supplied a bridge and trolley-based manipulator to Oak Ridge National Laboratory (ORNL) Radiochemical Engineering Development Center (REDC) in 1964. REDC produces radioisotopes for use in industry and research and processes more than 70% of the world's supply of 252Cf. The manipulator system in this hot cell was designed for hands-on maintenance and training and was not intended for use in a hot cell, however it installed on the REDC cell and suffered a bridge drive failure in 2008. Since no human access is possible in the cell replacement of the system presented an enormous challenge. Various repair, removal, replacement scenarios did not identify a solution that was workable in terms of cost and the spread of contamination, or potential exposure of personnel.
ORNL proposed a unique shield plug-mounted system that would not require removal of the failed system. The hot cell where the manipulator system is contained has a large (1830mm x 3050mm) ceiling plug. The proposed design provided equivalent functionality, capacity and complete cell coverage. In its retracted position the plug-mounted system can be installed and removed by removing the shield plug.
ORNL provided the design specifications, and hot cell coverage models and a rough working concept in SolidWorks. The concept and requirements were sent to PaR, who refined the concept and provided the detailed design, implementation and testing.
The new design consists of a plug-mounted 360 degree rotating turret and a two-stage horizontally extending boom with 2590mm of reach from the plug centerline. At the end of the boom a telescoping mast is attached with a vertical travel of 4268mm. A PaR M3000 manipulator with seven degrees of freedom is attached to the bottom of the mast.
ORNL fabricated a new shield plug and sent it to PaR's factory for fit-up and testing. The plug was designed to route all manipulator cables through conduits. Cables land on the top of the plug where bulkhead connectors are plugged into the cables that route to the control system. Therefore, installation of the new system is as simple as removing the old plug, installing the new plug with manipulator system attached and making the electrical connections. No personnel are exposed to radiation in the installation of the system.

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Session Classification: Remote Handling

Track Classification: Remote Handling

Contribution ID: **47** Type: **Poster**

3D Reconstruction of High Burnup U-7wt%Mo Dispersion Fuel using a Focused Ion Beam

Poster presentation of the FIB preparation and Analysis of irradiated fuel

Primary author: Dr MILLER, Brandon (Idaho National Laboratory)

Co-author: Dr CHICHESTER, Heather (Idaho National Laboratory)

Presenter: Dr MILLER, Brandon (Idaho National Laboratory)

Contribution ID: **48** Type: **not specified**

Welcome from the organizers

Monday, September 22, 2014 9:00 AM (15 minutes)

Primary author: Dr GAVILLET, Didier (Paul Scherrer Institut)

Presenter: Dr GAVILLET, Didier (Paul Scherrer Institut)

Session Classification: Opening

Contribution ID: **49** Type: **not specified**

Nuclear Energy in Switzerland: Perspectives for research

Monday, September 22, 2014 9:30 AM (20 minutes)

Presenter: Mr ZIMMERMANN, Martin (PSI - NES)

Session Classification: Opening

Contribution ID: **50** Type: **not specified**

Welcome from the HOTLAB Working Group

Monday, September 22, 2014 9:15 AM (15 minutes)

Presenter: Dr LEENAERS, Ann (SCK-CEN)

Session Classification: Opening