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The new STRESA tool for preservation of thermalhydraulic experimental data produced in the European Commission

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ABSTRACT

The experimental data recorded in Integral Effect Test Facilities (ITFs) are traditionally used in order to validate best estimate (BE) system codes and to investigate the behaviour of nuclear power plants (NPPs) under accident scenarios. In the same way, facilities dedicated to specific thermal-hydraulic (TH) severe accident (SA) phenomena are used for the development and improvement of specific analytical models and codes used in the SA analysis for light water reactors (LWR).

The extent to which the existing reactor safety experimental databases are preserved was well known and frequently debated and questioned in the nuclear community. The Joint Research Centre (JRC) of the European Commission (EC) has been deeply involved in several projects for experimental data production and experimental data preservation.

In this context the STRESA (Storage of Thermal REactor Safety Analysis Data) web-based informatics platform was developed by JRC-Ispra in the year 2000. At present the JRC STRESA database is hosted and maintained by JRC-Petten. The Nuclear Reactor Safety Assessment Unit (NRSA) of the JRC-Petten is engaged in the administration of a new STRESA tool that secures EU storage for SA experimental data and calculations. The development of this new STRESA tool was completed by early 2015 and published on the 25/06/2015 in the URL: http://stresa.jrc.ec.europa.eu/. The target was to keep the main features of the original STRESA structure but using the new informatics technologies that are nowadays available and providing new capabilities.

The objective of the paper is to describe, further disseminate and promote the usage of the new STRESA database containing important JRC experimental data and to demonstrate long-term importance of well-maintained experimental databases for the nuclear preservation of knowledge.

1. Introduction

During the last four decades a lot of effort has been dedicated to the evaluation of the NPP behaviour during accident conditions. Many complex best estimate system TH codes and TH specific models have been created developed and maintained for simulating the transient behaviour of LWR and are used to demonstrate the NPPs safety. Predictions of the TH codes are affected by uncertainty, consequently relevant experimental data simulating conditions expected in NPP, are needed to assess the validity of the computational models or system codes.

Huge efforts were done by the OECD/NEA Committee on Safety of Nuclear Installations (CSNI) from 1991 to 1997 in the construction of the so-called Validation Matrices for the validation of TH codes and models against relevant experimental data. Separate Effect Tests Facilities (SET) and ITFs have been used for already 30 years (Aksan et al., 1994; Annunziato et al., 1996).

The extent to which the existing reactor safety experimental databases are preserved either in paper or in electronic format was well known and frequently debated and questioned in the nuclear community, considering also the capital investment required to establish and conduct such large scale experimental programmes. This preservation is a mandatory requirement to support safety analysis and related training for future generations.

The JRC was engaged during decades in relevant SA experimental projects: The FARO, KROTOS facilities simulated Melt Fuel Coolant Interaction (MFCI) phenomena, considering either

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in-vessel (quenching) and ex-vessel (spreading) experiments and potential situations for steam explosions. The STORM facility simulated experiments in the area of aerosol transport. Also in the area of pure THs (ITFs) the JRC LOBI facility and its project produced data of 70 experiments simulating different accidents and transients in a PWR model.

Within this overall context the STRESA web-based informatic platform was developed inside the CERTA EC Project (Addabbo et al., 2003). The objectives of STRESA were to store and disseminate experimental documents and data and analytical documents coming from unique and large JRC experimental programmes (LOBI, FARO, KROTOS and STORM). LOBI and FARO facilities produced data from totally 90 experiments with a global cost of 150 Meur. The JRC STRESA database is hosted and maintained by JRC-Petten.

At present time the Nuclear Reactor Safety Assessment Unit (NRSA) of the JRC-Petten is engaged in the administration of a new STRESA tool that secures EU storage for SA experimental data and calculations. The development of this new STRESA tool was completed by early 2015 and published on the 25/06/2015 in the URL: http://stresa.jrc.ec.europa.eu/. The idea of the new STRESA tool was to keep the main features of the original STRESA structure but using the new informatics technologies that are nowadays available and providing new capabilities in the modern IT systems.

The new STRESA web platform that hosts the JRC facilities experimental data is presented in a chapter of the paper in order to introduce its new capabilities and further disseminate and promote the usage of the database containing these data. Other chapters are dedicated to a brief description of the JRC experimental programmes: LOBI, FARO, KROTOS and STORM.

2. The storage of thermal reactor safety analysis data (STRESA) database. Main features of the new STRESA tool

The JRC-Ispra developed from the year 2000 the JRC STRESA (Annunziato et al., 2001; Annunziato et al., 2005) web-based informatic platform in order to provide a secure repository of ITF and SET data exploiting modern computer information technologies for access and retrieve of the information. At the same time the JRC STRESA-SARNET network (Van Dorsselaere et al., 2011) was initially developed inside the EC FP6 Project Network SARNET-1 and it was actively used in the EC FP6 Project Network SARNET-2. Several individual nodes were connected to JRC STRESA-SARNET portal, containing severe accidents experimental data from several institutions. The JRC STRESA platform contains LOBI, FARO, KROTOS and STORM data belonging to experiments performed at the JRC Ispra during decades of severe accident studies by the EC.

Other STRESA nodes were developed along the years by other institutions, and some of them are still active containing large relevant experimental data (Davydov, 2009; Purhonen et al., 2006).

After the end of the EC FP6 Project Network SARNET-2 it was decided by the JRC-Petten to keep and update the STRESA tool with modern IT capabilities. In this context the development of a new STRESA tool became an initiative to support the NUGENIA network TA2 for SA data preservation.

The Nuclear Reactor Safety Assessment Unit (NRSA) of the JRC-Petten and in particular the Nuclear Reactor Accident and Modelling (NURAM) project is engaged in the administration of a new STRESA tool that secures EU storage for SA experimental data and calculations. The development of this new STRESA tool was completed by early 2015 and published on the 25/06/2015 in the URL: http://stresa.jrc.ec.europa.eu/.

The target was to keep the main features of the original STRESA structure but using the new informatics technologies that are nowadays available and providing new capabilities (assuring information security, implementing European Commission informatics standards, making available more information and links to other databases existing in EU countries to the public, implementing an advanced faceted search to filter and locate the data available in the information system and introducing communication tools such as forum and private messaging for connecting and engaging users with new tools for sharing knowledge).

All JRC's experimental data are physically located in JRC-IET servers in Petten. For other institutions the possibility is given to use the new STRESA tool to store their own data. For institutions willing to use this new STRESA tool, all data will be physically also stored in JRC-IET servers in Petten but release or modification of these data will remain always under the sole responsibility of the institution owning the data, as it has been always one of the main features of the system. This includes the institutions that in original STRESA configuration were participating with STRESA nodes (physically located in their institutions) forming STRESA networks and that have already agreed to transfer their data to the new STRESA or are considering to do so. In the case of keeping their own data systems a link is shown to the institution system.

A point to emphasize in the new system is its special care about the information security. The Commission Decision of 16 August 2006 C(2006) 3602 concerning the security of information systems used by the European Commission establishes a series of requirements, measures and practices for the protection of the Commission's information systems and the information processed therein against threats to the availability, integrity and confidentiality of these systems and information. Being STRESA one of the Commission's information systems, it is bound to comply with the demanding information security standards established in this way at the highest level.

The STRESA database was planned with specific requirements that were very clear from the first versions of the tool and that will be kept in the new tool: 1 – In order to have full accessibility from any place, the database had to be accessed via Internet. 2 – The accessibility of data had to be controlled whenever. 3 – The authorization to access to specific documents or data is performed locally, by responsible or owner of data of a specific facility or test, not by an overall institution, external to data, except in case of specific authorizations. The 3rd requirement was a very important feature of STRESA tool. The issue of releasing experimental data to external organizations has been a point discussed in several forums during the years. It is clear that the owner of data wishes to control at any time this release of data to third parties. These features resulted in a very attractive characteristic of the tool for many institutions to adopt STRESA nodes or to participate with their own nodes in a common network.

The documents in STRESA are accessed in hierarchical mode. The general structure for experimental facilities may be: Facilities → Tests → Documents/Data. For each of these tests an arbitrary number of documents may have been stored. The documents/data can have different levels of protection decided by the responsible/owner of the data when uploaded them on the server.

The usual procedure to access specific tests documents or data by the user is to make a request via the STRESA web page to the responsible of the data, indicated in the documents/data list. It will be also possible for a user belonging to an institution to have specific permissions given to the institution.

2.1. Components

The new STRESA information system will run in a virtual Apache web server with standard CentOS Linux installation making use of the following software configuration:

- **Drupal**: Drupal is used as the content management framework for the new STRESA. It is open source software written in PHP.
- **MySQL**: MySQL is used as the relational database management system for DRUPAL. It is open source software written in C and C++.
- **Apache Solr**: Solr is used as the enterprise search engine for STRESA. It is open source software written in JAVA.

In order to meet all the STRESA feature requirements as well as those of the European Commission regarding appearance and information security, the Drupal core has been extended with specific addons and customized modules, making the new STRESA a specific and unique knowledge management tool.

Fig. 1 represent experiments page of the new STRESA tool.

2.2. Features

The new STRESA will offer to its users several new interfaces that will allow an intuitive and efficient interaction with the data stored in the information system and with the other users making greater value out of it.

- **Search**: Data stored in the new STRESA may be explored in two different ways:
  - by using full-text search, in which the user just write one or more keywords in the text box, and the system answers with all the records that contain these words;
  - or by applying multiple filters to the list of results using the facets proposed by the information system.
- **Forum**: The forum is the place where users can express comments, ideas, proposals or the problems they are experiencing while using the information system. The character of the topics discussed in the forum is open and therefore it may include practical aspects related to the use of the information system itself but also other subjects related with nuclear technology and severe accidents.
- **Private messaging**: In order to avoid overloading the users' mailboxes with emails generated automatically by STRESA, the new information system contains its own private messaging tool, where the user will find the messages related with the status of its data downloading permission requests as well as private messages from other users that for example want to share a particular piece of content or pose a specific question.
- **Data access administration**: Users will find in the new STRESA a new interface (Fig. 2) allowing the real time monitoring (requests pending, denied or granted) of the data downloading permissions that they have requested themselves or that somebody has requested to them, whenever the user is the responsible of the data from a particular experiment. The actions performed through this interface may also be reversed at any time if necessary.

2.3. User roles

Before logging-in, all the STRESA visitors are considered as **Anonymous** users. Every logged-in user (apart from the Administrator of the tool) of the new STRESA information system will be assigned to one of the following roles:

- **Viewer**: The Viewer users are registered in the information system once they have provided information about their employer and the details from their European Commission Authentication System (ECAS) account. Their access location is diverse, and their use of the information system is limited to the following actions, that are also available to the rest of the user roles:

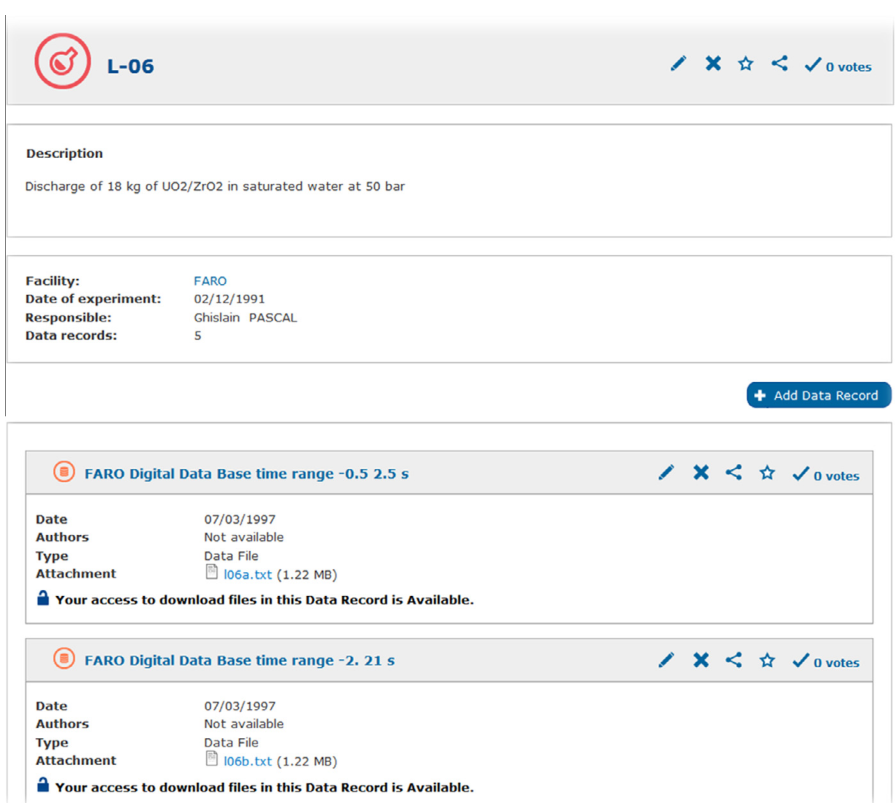

Fig. 1. Experiment page appearance of the new STRESA tool.

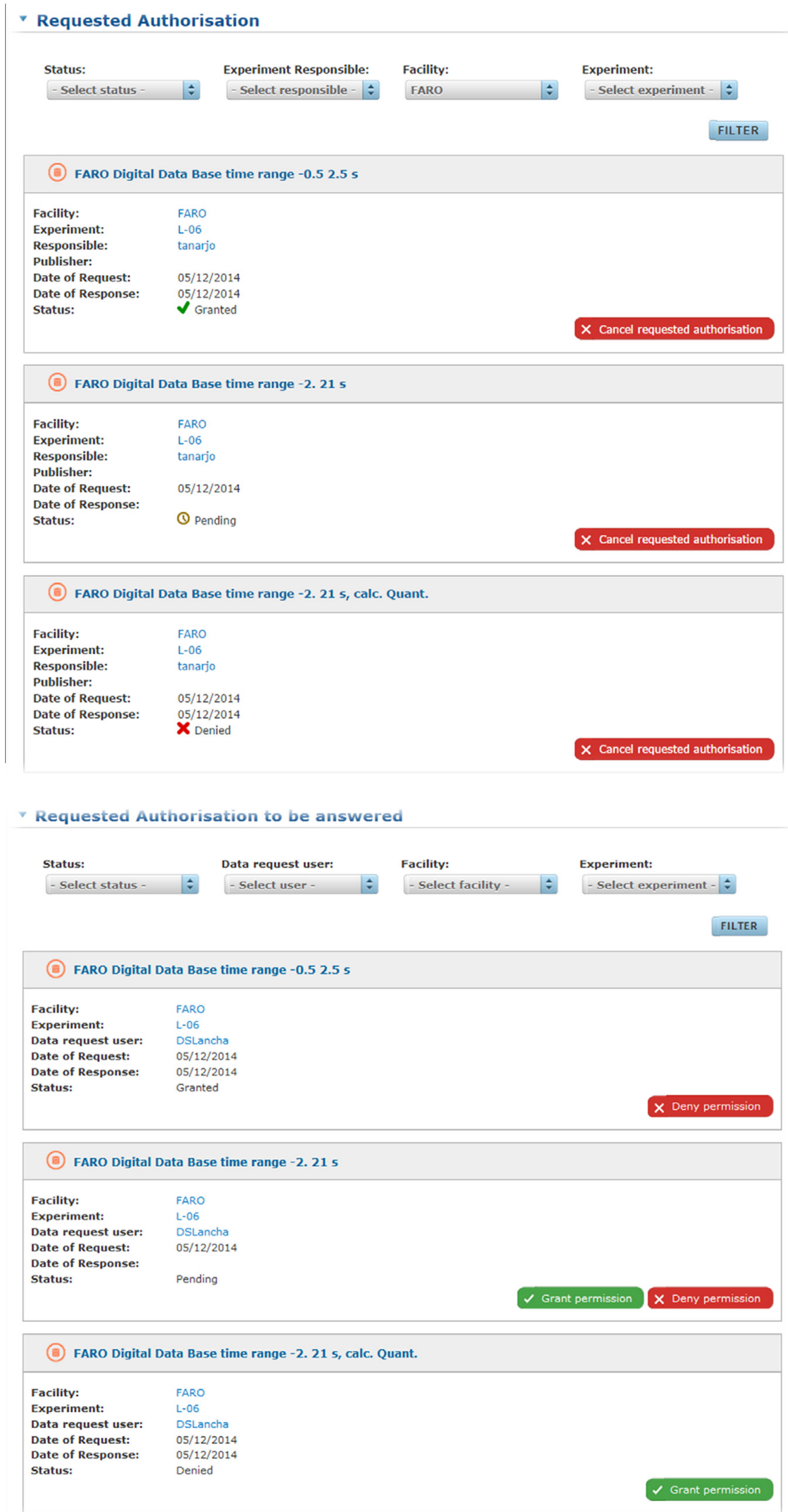

Fig. 2. User interface for data access of the new STRESA tool.

 ○ Information browsing by using the menus and the search features.
 ○ Requesting downloading permission to Data.
 ○ Contribution to the site's content through comments and votes.
 ○ Private messaging.
- **Researcher**: These users are members of the European research organisations contributing to STRESA. Their working locations are spread all over the European Union. Their use of the information system depends on the needs of their research organisation, but in general the principal activity would be the administration of its own experiments data including the following actions:
 ○ Creation and edition of records of experiments inside facilities of their own organisation.
 ○ Creation and edition of records of data (any document or experimental data belonging to a specific test) inside the experiments of their own organisation.
 ○ Administration of downloading permission requests to data included in experiments under their responsibility.
 ○ Creation and edition of records of type 'topic' inside the forum.
- **STRESA**: The STRESA users are members of the NURAM project from the European Commission and their working location is the JRC-Petten. The STRESA users are the main contributors of the information system holding the responsibility of all its public content. The STRESA user can perform all the actions available for the Researcher plus the creation and edition of records corresponding to a facility, 'news', 'activity' and 'links'.

2.4. Visibility

Table 1 below presents the roles and their rights in each of the interfaces of the information system. The permissions presented for the data records are only indicative as the detailed logic depends on the visibility status, defined later.

- 👁: Right of view.
- ✎: Right of view, edition and grant downloading permission to data.
- 💬: Right of view and commenting.
- 🔑: Right of view and request downloading permission to data.
- ⬇: Right of downloading data.
- ✔: Right of using the functionality.
- 🚫: Access denied.

The right of seeing, editing and downloading a particular ***data record*** depends on its visibility status. Table 2 shows a summary of the data visibility and the user rights.

The visibility status facilitates the data downloading permission administration to the data responsible by applying standard access logics:

- **Open**: Every logged-in user is able to see and download the data.
- **Restricted**: Every logged-in user is able to see the data. Logged-in users with roles STRESA and Researcher are able to download the data. Users with role Viewer need to request downloading permission to the data responsible unless the data belongs to its own organisation or to a research partner.
- **Private**: Every logged-in user is able to see the data. Logged-in users with role STRESA are able to download the data. Logged-in users with roles Researcher and Viewer need to request downloading permission to the data responsible unless the data belongs to its own organisation.
- **Hidden**: Logged-in users with roles STRESA and Researcher can only see and download the data that belongs to its own organisation. Logged-in users with role Viewer cannot see nor download any hidden data.
- **Obsolete**: Logged-in users with roles STRESA and Researcher can see the data that belongs to its own organisation, but they cannot download it. Logged-in users with role Viewer cannot see nor download any obsolete data.
- **Undefined**: Data with no defined visibility. This is meant to be a very unusual status resulting from possible specific temporary situations. It completes the logic of the tool.

This way, each Researcher may apply to its own data the visibility status that adapts better to the policy of its research organisation.

3. The Lobi thermalhydraulic safety research programme

The LOBI (LWR off-normal behaviour investigation) was a reactor thermalhydraulic safety research programme carried out by the JRC-Ispra site (Addabbo and Annunziato, 2006; Addabbo and Annunziato, 2000) from a joint undertaking between the EC and the former Bundesminister für Forschung und Technologie (BMFT) of Germany. The main objective was the investigation of basic phenomenologies governing the thermalhydraulic response of an ITF for a range of PWR operational and accident conditions; the programme was also aimed to the provision of an experimental data base.

Table 1
User roles and rights in the new STRESA tool.

	Same Organization?	Facilities	Experiments	Data (see next table)	News, Activities and Links	Share, Rate, Favourites	Forum
Stresa	No / Yes	✎	✎	✎ all + ⬇	✎	✔	✎ all + 💬
Researcher	No	👁	👁	🔑	👁	✔	✎ own + 💬
	Yes		✎	✎ own + ⬇			
Viewer	No	👁	👁	🔑	👁	✔	💬
	Yes			⬇			
Anonymous	No / Yes	👁	🚫	🚫	👁	🚫	🚫

Table 2
Data visibility and user rights in the new STRESA tool.

	Visibility status	Data (owner)	View	Edit	Download
Stresa	Undefined	Own	✓	✓	✓
		Same org.	✓	✓	✓
		Different org.	✓	✓	✓
	Open	Own	✓	✓	✓
		Same org.	✓	✓	✓
		Different org.	✓	✓	✓
	Restricted	Own	✓	✓	✓
		Same org.	✓	✓	✓
		Different org.	✓	✓	✓
	Private	Own	✓	✓	✓
		Same org.	✓	✓	✓
		Different org.	✓	✓	✓
	Hidden	Own	✓	✓	✓
		Same org.	⊘	⊘	⊘
		Different org.	⊘	⊘	⊘
	Obsolete	Own	✓	⊘	⊘
		Same org.	⊘	⊘	⊘
		Different org.	⊘	⊘	⊘
Researcher	Undefined	Own	✓	✓	✓
		Same org.	✓	✓	✓
		Different org.	⊘	⊘	⊘
	Open	Own	✓	✓	✓
		Same org.	✓	✓	✓
		Different org.	✓	⊘	✓
	Restricted	Own	✓	✓	✓
		Same org.	✓	✓	✓
		Different org.	✓	⊘	✓
	Private	Own	✓	✓	✓
		Same org.	✓	✓	✓
		Different org.	✓	⊘	⊘
	Hidden	Own	✓	✓	✓
		Same org.	⊘	⊘	⊘
		Different org.	⊘	⊘	⊘
	Obsolete	Own	✓	⊘	⊘
		Same org.	⊘	⊘	⊘
		Different org.	⊘	⊘	⊘
Viewer	Undefined	Others	⊘	⊘	⊘
	Open	Others	✓	⊘	✓
	Restricted	Same org. (or Research Partner)	✓	⊘	✓
		Different org.	✓	⊘	⊘
	Private	Same org.	✓	⊘	✓
		Different org. (including Research Partner)	✓	⊘	⊘
	Hidden	Others	⊘	⊘	⊘
	Obsolete	Others	⊘	⊘	⊘

The LOBI ITF (Fig. 3) was a single plus a triple loop (simulated by one loop) full-power high pressure integral system test facility representing an 1:712 scale (core power, volume and mass flow) model of a 4-loop, 1300 MWe PWR (Siemens-KWU type, Biblis B NPP reactor), built and located at the JRC-Ispra site. The LOBI ITF incorporated the essential features of a typical PWR primary and secondary cooling system. The measurement system comprised a total of about 470 measurement channels.

The LOBI-MOD1 test facility configuration was designed mainly to meet the relevant requirements of Large and Medium Break Loss of Coolant Accidents (LB and MB LOCAs). A total of 28 tests were performed with this configuration during the period December 1979 to June 1982. The LOBI-MOD2 test facility configuration, operating since April 1984, represents an upgraded version designed to meet also all relevant requirements related mainly to the investigation of Small Break (SB) LOCAs and Special Transients. A total of 42 tests were performed in the period April 1984 to June 1991.

For each test the planned mandatory documentation produced included: Digital data set (measured experimental parameters), Experimental Data Report (EDR) and Quick Look Report (QLR). Test prediction reports (pre-tests) and Test comparison reports (post-tests) were produced optional as complementary documentation. Experimental data and documentation of all tests (EDR, QLR, videos...) are available on-line through the JRC STRESA web database platform.

Many LOBI tests were highly relevant for the understanding of thermalhydraulic phenomena and for system code assessment, mainly performed inside the duration of the LOBI programme, during the 80's and early 90's by the participants of the project (LOBI Seminar Proceedings, 1992). In addition a demonstration of the long-term importance of well maintained databases like STRESA is that in the recent years (last 6–7 years) several code validation activities were performed against LOBI experimental data in universities and research centres.

3. The FARO severe accident research programme. The FARO and the KROTOS facilities

The primary objective of the FARO research program was aimed to acquire a reference experimental data base from tests performed in the FARO installation with realistic melt composition and under reactor typical accident conditions. The experimental data is essential for the development and improvement of analytical models dedicated to the phenomena. The programme aimed also to investigate basic phenomena relevant to the progression of severe accidents in water cooled reactors with particular emphasis on the interaction of molten fuel with coolant and/or structures under both in-vessel and ex-vessel postulated severe accident conditions.

3.1. The FARO facility

The FARO (Furnace And Release Oven) was an experimental facility operated by the JRC-Ispra (Annunziato et al., 1997). The FARO facility (Fig. 4) began the experiments or tests of the LWR-MFCI phenomena in 1990 in collaboration with several reactor safety research organizations from EC member countries and with the participation of the US Nuclear Regulatory Commission (USNRC). The interaction of large masses (up to 200 kg) of prototypical corium melt mixtures (e.g., $UO2/ZrO2$, $UO2/ZrO2/Zr$) in the water under a variety of realistic accident conditions was studied. The reference scenario is relevant to a postulated in-vessel core melt down accident when jets of molten corium penetrate into the lower plenum water pool, fragment and settle on the lower head.

In its configuration, the FARO test facility comprised five main major components that include the furnace, the intersection valve, the release vessel or melt catcher, the interaction test section and the venting system. From Test L-14 to L-24 the TERMOS interaction test section was used (0.71 m of diameter and about 1.5 m^3 of volume). From Test L-27 it was changed to FAT test vessel, which consisted of a pressure vessel of 1.5 m internal diameter and 2 m high, designed for a pressure of 8 MPa and a temperature of 300 °C. The facility was properly instrumented in order to characterize the evolution of the interaction process.

12 quenching tests were performed in the FARO facility: 5 at 50 bar initial pressure, 1 at 20 bar and 6 tests at pressure lower than 5 bar in the TERMOS and FAT vessel configurations. In the last test L-33 performed in July 1999 an external trigger was applied. Another configuration was used, SARCOFAGO (Fig. 4, right) to investigate the impact on the core catcher of corium ejected after reactor pressure vessel failure during a core meltdown accident. Two tests have been performed in the FARO facility, one with a dry surface and one with 1 cm of water layer. Experimental data and documentation of all tests (EDR, QLR, videos...) performed at the FARO facility are available on-line through the JRC STRESA web database platform. FARO experiments have been used in several contexts (Pla et al., 2001). FARO experiments L-28, L-31, L-33 were selected in the framework of the SERENA (Steam Explosion REsolution for Nuclear Applications) project (2002–2006). This programme was dedicated to MFCI remaining issues for LWRs (OECD resear, 2007).

3.2. The KROTOS facility

KROTOS was another facility located in the JRC-Ispra site for MFCI studies (Huhtiniemi et al., 1999). It was a relatively small scale experimental installation dedicated to the study of molten fuel coolant premixing with little masses (up to 5 kg) of prototypic reactor melts or simulants as alumina (Al_2O_3). The progression of spontaneous and triggered energetic fuel coolant interactions (steam explosions) was also studied. The KROTOS main objective was to provide basic experimental information on MFCI phenomena relevant to severe accident situations in nuclear reactors. The results of tests give information about the energetics of the interactions and can be used for the validation of other computer models which describe mechanistically the processes of thermal detonations. The melt penetration and premixing data can also be used to validate in small scale the fuel–coolant mixing computer code models.

The KROTOS facility (Fig. 5) consisted of a stainless steel test section bolted to lugs welded on the inner side walls of a stainless steel pressure vessel. The cylindrical pressure vessel, inner diameter 0.4 m, height, 2.21 m, had a thick flat bottom and a flanged flat upper head and was designed to withstand a static pressure of 2.5 MPa at 493 K. The cylindrical test section, inner diameter 200 mm, outer diameter 240 mm, closed at the bottom by either a flat plate or with a gas trigger device, could contain water up to a height of about 1.27 m (about 40 l). The furnace, maximum electric power 130 kW, consists of a cylindrical tungsten heater, which encloses the tungsten or molybdenum crucible containing the melt material. The test facility was properly instrumented in order to characterize the evolution of the interaction process.

KROTOS experiments were performed in the frame of the FARO programme. Experimental data and documentation of all tests (EDR) performed at the KROTOS facility are available on-line through the JRC STRESA web database platform. KROTOS was transferred to CEA Cadarache at the end of the JRC-Ispra MFCI programme in 1999. It is at present part of the French institute research programme on severe accidents. In this context inside the OECD-NEA SERENA project 2nd phase (2007–2012) five of the six tests planned in the KROTOS facility were performed at the end of 2011 (Steam Explosion Resolution for Nuclear, 2007).

4. The STORM facility

The STORM (Simplified Test On Resuspension Mechanism) facility (Bujan et al., 2010) was operated by JRC-Ispra. The facility was designed to work with high concentration of soluble and insoluble aerosol materials (up to 25 g/m^3), a wide range of aerosol compositions, size distribution and density and high carrier gas and steam flow rate (about 1 kg/s). The test section was located downstream of the mixing vessel; it consisted of four steel pipes connected in series and/or parallel (Fig. 6).

The first pipe between the mixing vessel exit and the test pipe inlet (total length ≈4 m) was thermally insulated in order to reduce thermophoretic deposition and heat losses as well as to

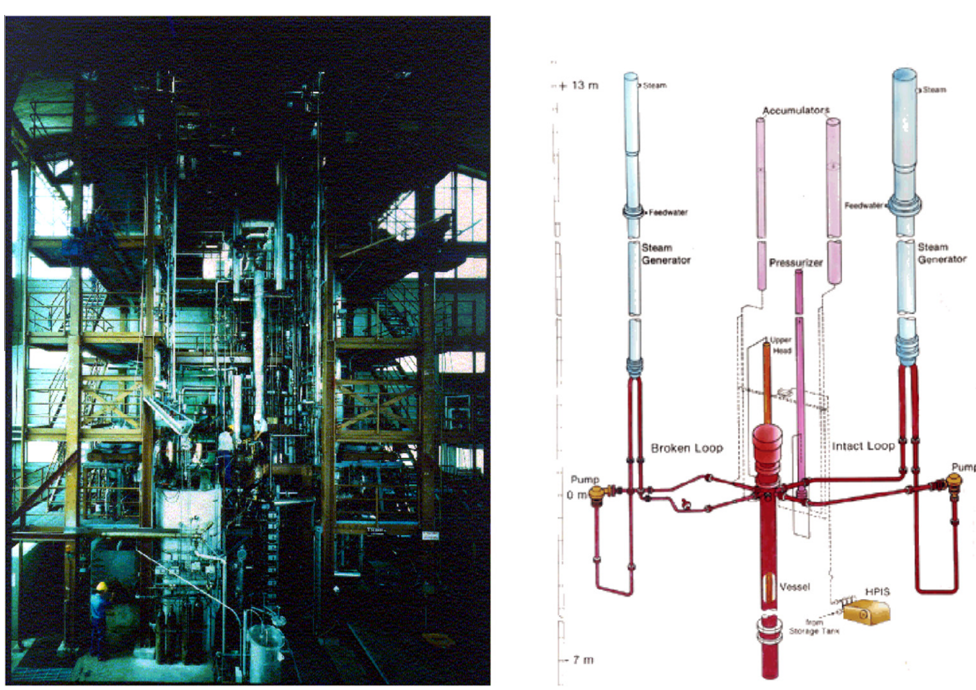

Fig. 3. LOBI-MOD2 ITF photograph and schematic representation of the cooling system.

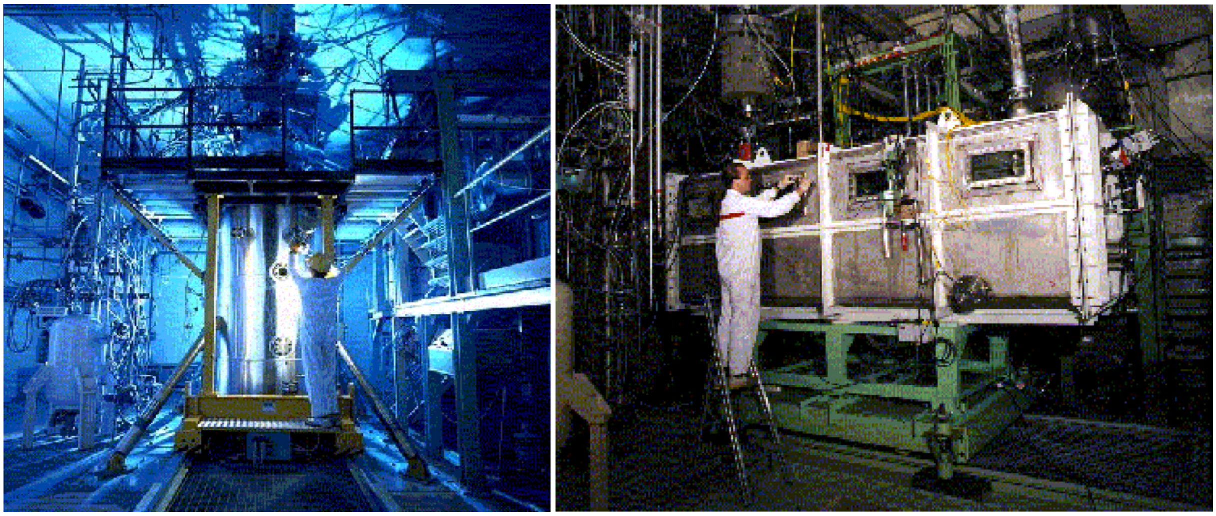

Fig. 4. Outside view of FARO Test facility with FAT release vessel for melt quenching experiments (left) and FARO SARCOFAGO test vessel for melt spreading experiments (right).

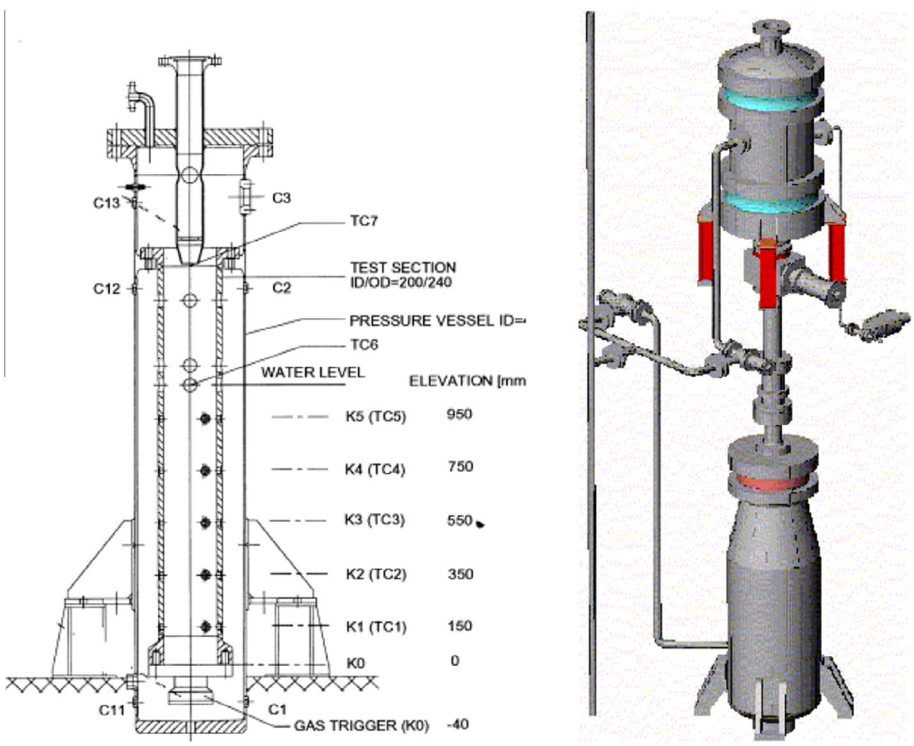

Fig. 5. View and sketch of KROTOS test facility.

avoid steam condensation. The 63-mm inner diameter test pipe was 5 m long and was surrounded by an oven to keep the pipe wall temperature at the required levels during the deposition and resuspension phases. In the deposition phase, the carrier gas and aerosols pass through the mixing vessel a first straight pipe into the test section and then straight to the wash and filtering system. In the resuspension phase, the clean gas was injected through the resuspension line directly into the test section and the resuspended aerosols were collected in the main filter before the gas goes through the wash and filtering system.

The aerosol concentration and size distribution were measured upstream of the test section in the deposition phase of the experiment and downstream of the test section in the resuspension phase. The gas flow temperatures at the vessel outlet and in the test section were generally stabilized within 1 h. Thirteen thermocouples are located on the outer wall surface. At the test pipe exit, along the inner radius of the pipe, the gas temperatures were measured in three locations: in the centreline of the pipe; at a distance of ≈10 mm (about one third of the pipe radius) from the inner wall surface; and on the inner wall. In each test, the absolute fluid pressure was set at 0.1 MPa. STORM tests can be subdivided into four phases: (1) heat-up phase (2) temperature stabilization phase (3) aerosol deposition phase, and (4) aerosol resuspension phase.

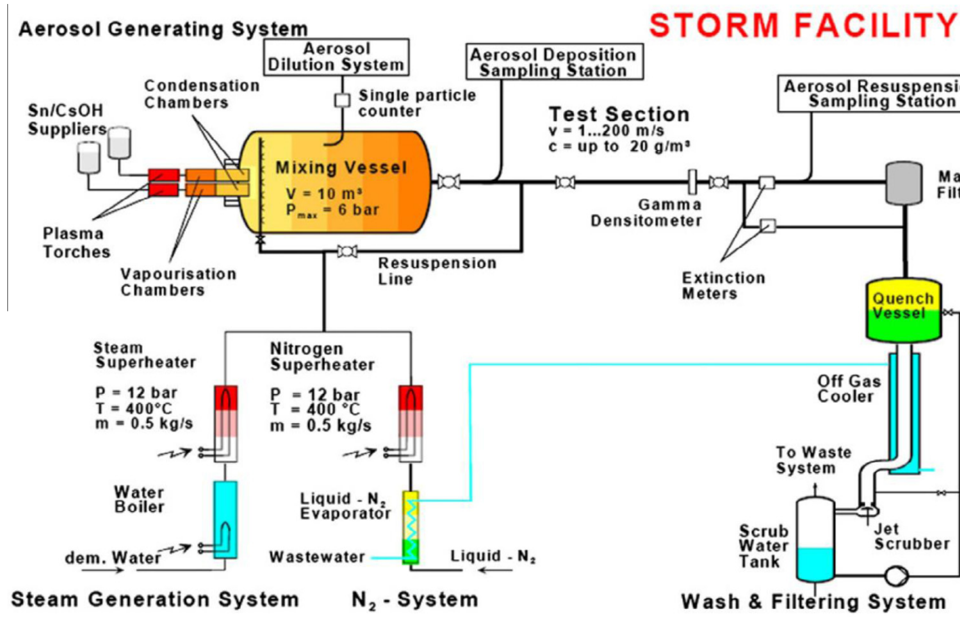

Fig. 6. Sketch of STORM test facility.

International Standard Problem (ISP)-40 de los Reyes Castelo et al., 1999 was set up to address aerosol deposition and resuspension phenomena in the reactor cooling system and was based on test SR11 of the STORM series performed in 1997. The scenario was one of nuclear aerosol deposition in the relief lines of a PWR during a steam blackout followed by resuspension of the deposits by the steam surge resulting from a core slump. Like other STORM tests the experiment upon which this ISP was based took place in two phases. In the deposition phase SnO_2 simulant aerosol was transported through a horizontal test section (diameter 63 mm, length 5000.5 mm) by a carrier gas consisting of a mixture of steam, N_2, air, Ar and He. In this resuspension phase, nitrogen gas was passed through the test section in a series of mass flow rate plateaux, and the mass resuspended during each phase and its size distribution were measured by downstream sampling stations.

Experimental data and documentation of all tests (EDR) performed at the STORM facility are available on-line through the JRC STRESA web database platform.

5. Conclusions

STRESA (Storage of Thermal REactor Safety Analysis Data) web-based informatic platform was developed in its first version in the year 2000, in order to provide a secure repository of thermal-hydraulic and severe accident experimental data. The structure and the characteristics of the new STRESA tool in development were presented in the paper, emphasizing the new capabilities in its components, features, user roles and visibility of data.

The development of this new STRESA tool was completed by early 2015 and published on the 25/06/2015 in the URL: http://stresa.jrc.ec.europa.eu/. The idea of the new STRESA tool was to keep the main features of the original STRESA structure but using the new informatics technologies that are nowadays available and providing new capabilities in the modern IT systems.

A point to emphasize in the new system is its special care about the information security. The Commission Decision of 16 August 2006 C(2006) 3602 concerning the security of information systems used by the European Commission establishes a series of requirements, measures and practices for the protection of the Commission's information systems and the information processed therein against threats to the availability, integrity and confidentiality of these systems and information. Being STRESA one of the Commission's information systems, it is bound to comply with the demanding information security standards established in this way at the highest level. In this context the JRC Petten gives the possibility to external institutions to use the new STRESA tool to store their own data. All data will be physically stored in JRC-IET servers in Petten but release or modification of these data will remain always under the sole responsibility and control of the institution owning the data.

The paper also presented the JRC stored experimental data in the STRESA database in order to further disseminate and promote the usage of the database containing these data.

The activities performed along the years and LOBI, FARO, KROTOS and STORM data for system code assessment demonstrate the long-term importance of well maintained databases like STRESA. Access to reactor safety thermalhydraulic databases will be a continuing requirement to support the assessment/improvement of current system codes. These activities are also crucial points in the maintaining and transferring human resources capabilities from senior to young generations in the area of nuclear safety, where industry, regulator, academia and research organizations have to work together to avoid decrease or lack of skilled resources in the future decades.

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