Main Benefits from half a century of NEA Collaborative Projects in Nuclear Safety

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- NEA Evolution, Mission and Strengths
- Joint Projects summary and achievements
- Main benefits from OECD/NEA Joint Nuclear Safety Research Projects
- Continued development of OECD/NEA JRSPs
- Concluding Thoughts
- Final Message

The NEA's Evolution

- Founded in 1958 as ENEA (European)
- Became NEA in the 1970s when Japan, Australia, the U.S. and Canada joined
- Present membership: 31 member countries
- Role has changed
  - initial focus was on joint research projects
  - later developed to a forum for co-ordination of policies/programmes
  - outreach since early 1990s

OECD/NEA Membership

- Australia
- Austria
- Belgium
- Canada
- Chile
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Israel
- Italy
- Japan
- Korea
- Luxembourg
- Mexico
- Netherlands
- New Zealand
- Norway
- Poland
- Portugal
- Russia
- Slovak Republic
- Slovenia
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom
- United States

OECD and NEA member
OECD member, not NEA
NEA member, not OECD

The NEA Mission

- To assist its member countries in maintaining and further developing, through **international co-operation, the scientific, technological and legal bases** required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes.

- To provide authoritative assessments and to forge **common understandings** on key issues, as **input to government decisions on nuclear energy policy**, and to broader OECD policy analyses in areas such as energy and sustainable development.

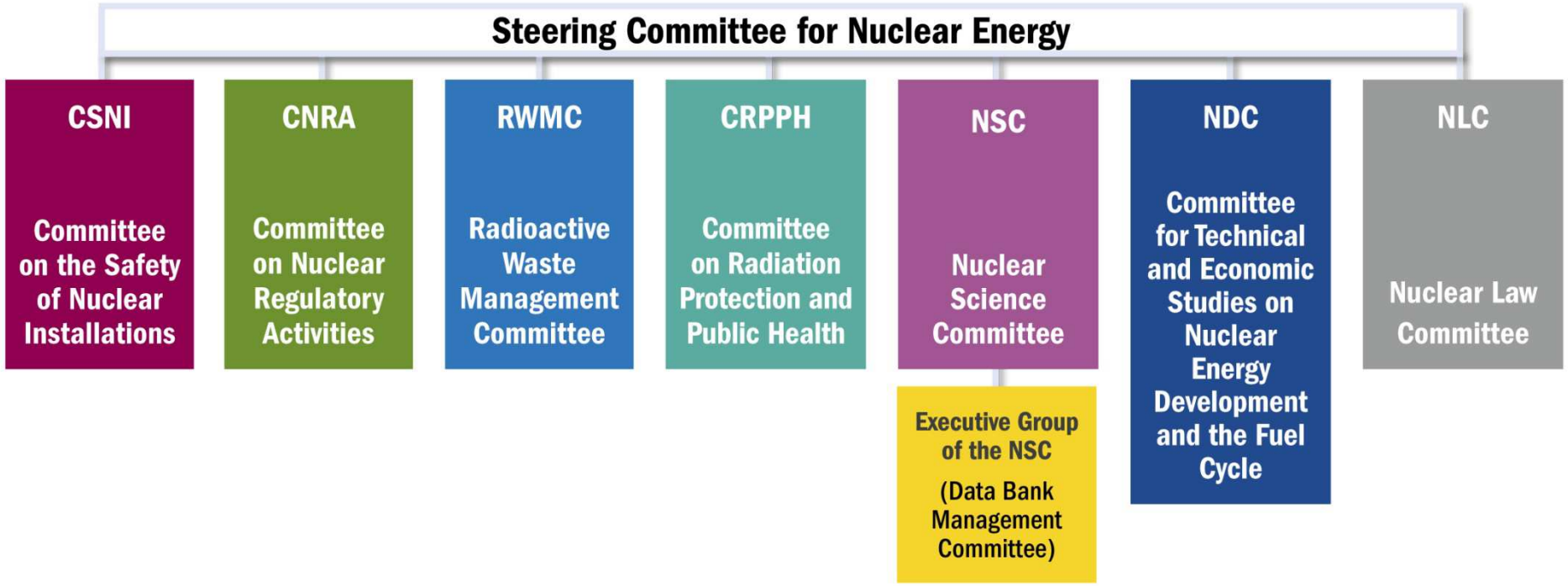
NEA Basic Characteristics

- Organisation of member country governments
- Semi-autonomous Agency of OECD
- Two parts: Main Secretariat and Data Bank with separate memberships/budgets
- Co-operates closely with the International Atomic Energy Agency (IAEA) and the European Commission (EC)
- General condition of “mutual benefit”, NEA is not an organisation providing assistance

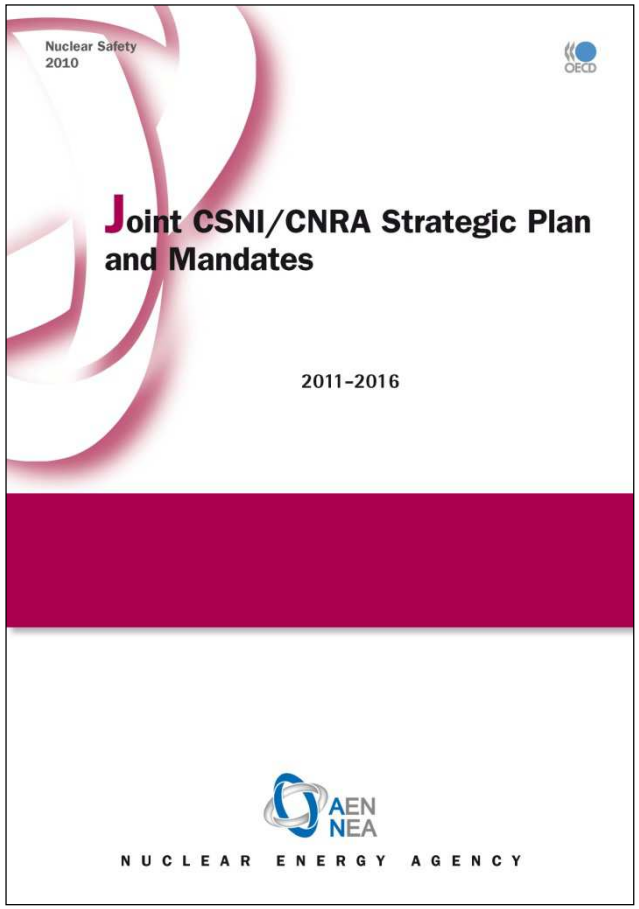
NEA Strengths

- Small size and budget
  - (80 staff members; low budget agreed with Member Countries, + voluntary contributions and projects).
- Large representation (85% of the world's nuclear power capacity).
- Non-political forum; climate of mutual trust.
- Tries to pool world's best nuclear expertise among developed countries.
- Narrow focus: in-depth scientific, technical, legal work.
- Cooperation forum for non-Member Countries identified by Steering Committee

NEA Committees



CSNI/CNRA Joint Strategic Plan



Main Challenges (2011 – 2016)

- Adequate Nuclear Skills and Infrastructure
- Effectiveness and Efficiency of Activities Related to Safety
- Safe Operation of Current Nuclear Facilities
- Safety in New Nuclear Facilities
- Safety in Advanced Reactor Designs

Committee on the Safety of Nuclear Installations (CSNI)

- CSNI Progamme Review Group (CSNI PRG)
- Working Group on Risk Assessment (WGRISK)
- Working Group on Analysis and Management of Accidents (WGAMA)
- Working Group on Integrity and Ageing of Components and Structures (WGIAGE)
  - Subgroup on the Integrity of Metal Components and Structures
  - Subgroup on the Ageing of Concrete Structures
  - Subgroup on the Seismic Behaviour of Components and Structures
- Working Group on Human and Organisational Factors (WGHOF)
- Working Group on Fuel Safety (WGFS)
- Working Group on Fuel Cycle Safety (WGFCS)
- Senior Expert Group on Safety Research Opportunities Post-Fukushima
- Task Group on Natural External Events
- Task Group on Robustness of Electrical Systems of NPPs in Light of the Fukushima Daiichi Accident (ROBELSYS)

Joint Projects

10 Active Projects
5 Projects Closing
1 Project starting
4 Ongoing Databases

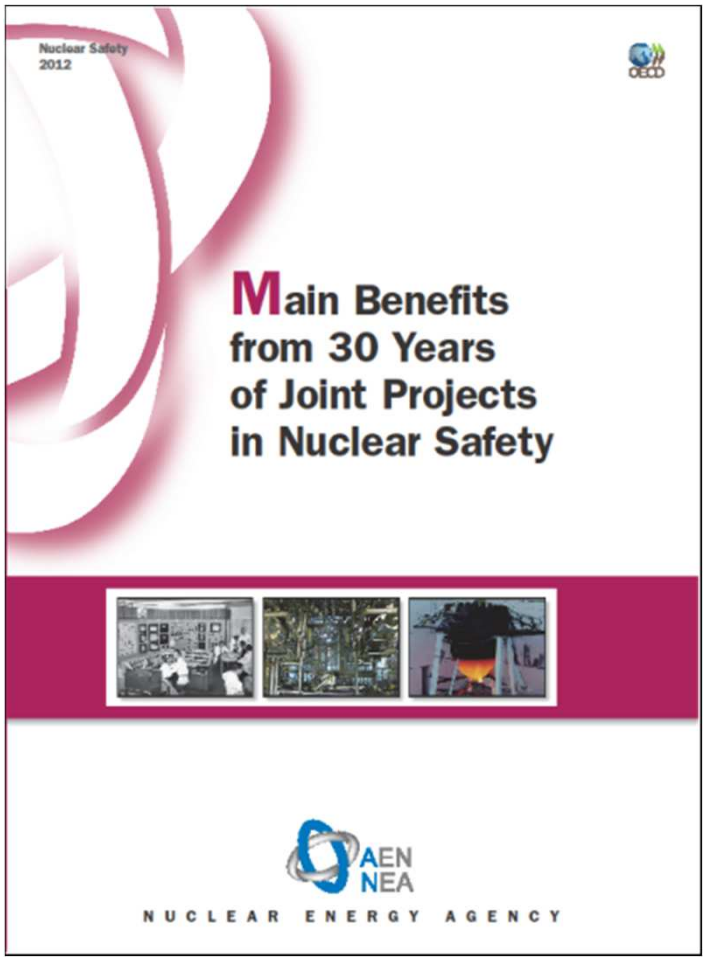
Potentially 4 project follow-ups

26 Closed Projects

2012 Report on Safety Projects achievements

Decision post-Fukushima to review the Joint Nuclear Safety Research Projects existing prior to the events

- Scope
- Benefits
- Inform future work



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OECD 2012

- Authors

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Purpose of the "30-years" Report

- Describe the achievements of the OECD/NEA Joint Projects on safety research (other than Halden) that were carried out during the last three decades with a specific focus on:
  - thermal hydraulics,
  - fuel behaviour,
  - severe accidents.
- Show that the resolution of specific safety issues in these areas has greatly profited from Joint Projects.
- Point at the benefit of working together for maintaining unique experimental infrastructure, preserving skills and generating new knowledge.

OECD/NEA Halden Reactor Project

The Halden Reactor Project scope and duration is too large to be properly covered in the report **– Over half a century of International collaborative working**

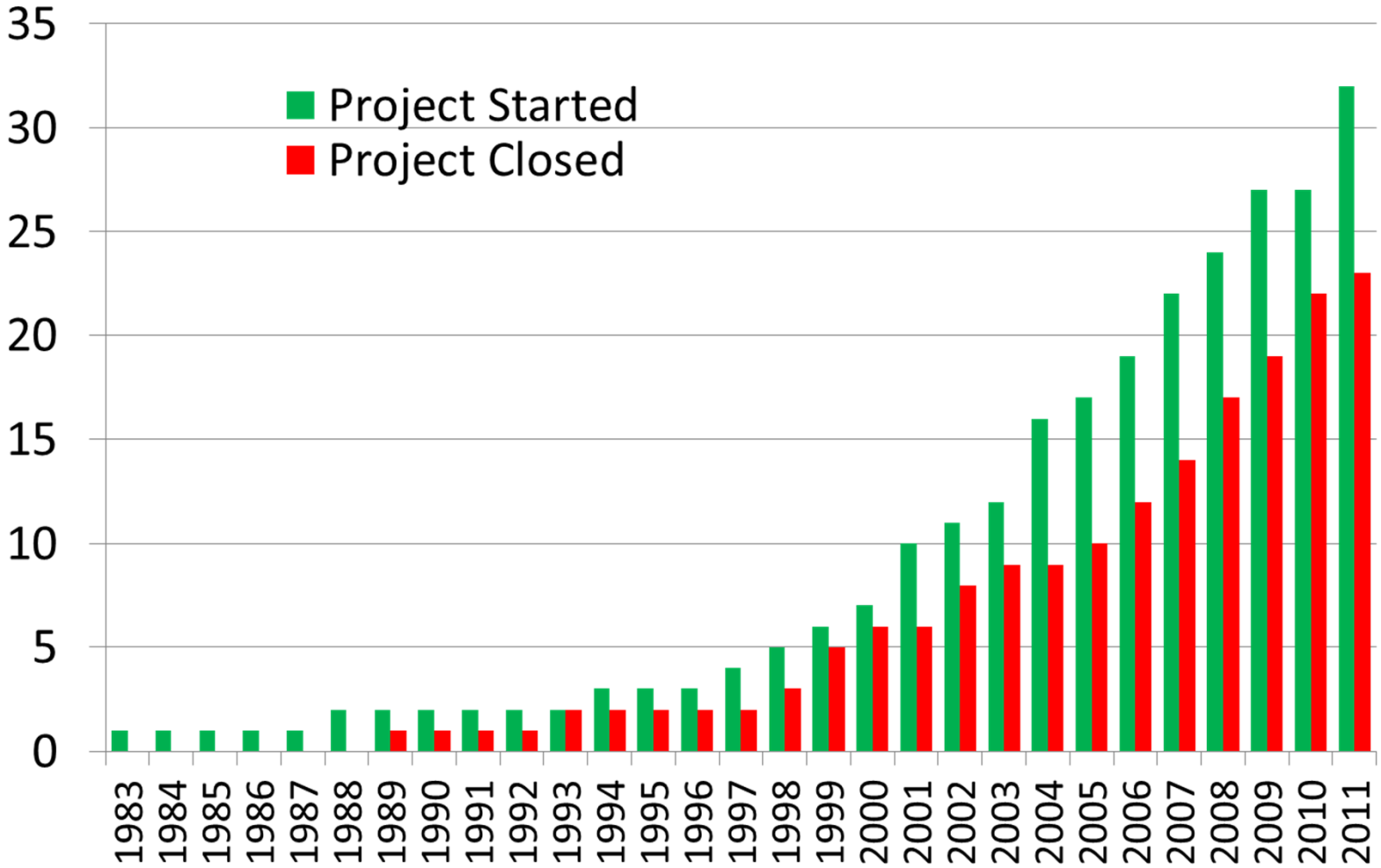
- In operation since 1958 and the largest NEA joint project
- Important international technical network in the areas of nuclear fuel reliability, integrity of reactor internals, plant control/monitoring and human factors.
- Carried out at the Halden establishment in Norway, and is supported by more than 130 organisations in 19 countries.
- The programme of work is in general split into two areas
  - The Fuel and Materials programme
  - The man, technology and organisation programme
- a stable and well-experienced organisation, the technical infrastructure and the project objectives have undergone substantial upgrades and continual adaptation to users' needs over the years.

OECD/NEA Joint Nuclear Safety Research Projects

Motivations and Goals

- Resolve issues relevant for the nuclear community by means of research shared by many countries
- Enhance technical exchange, co-operation and consensus-building internationally
- Support the continued operation of unique test facilities which are of value to the OECD/NEA nuclear community
- CSNI is committed to promote and facilitate Safety Research, through scientific and technical cooperation between member countries
- The availability of safety research results is key in assuring the high level and long-term safety of nuclear facilities
- This goal can however only be reached if dedicated and sustained funding for safety research is maintained. The availability of experimental infrastructures is also essential

Cumulative Number of Projects to 2011

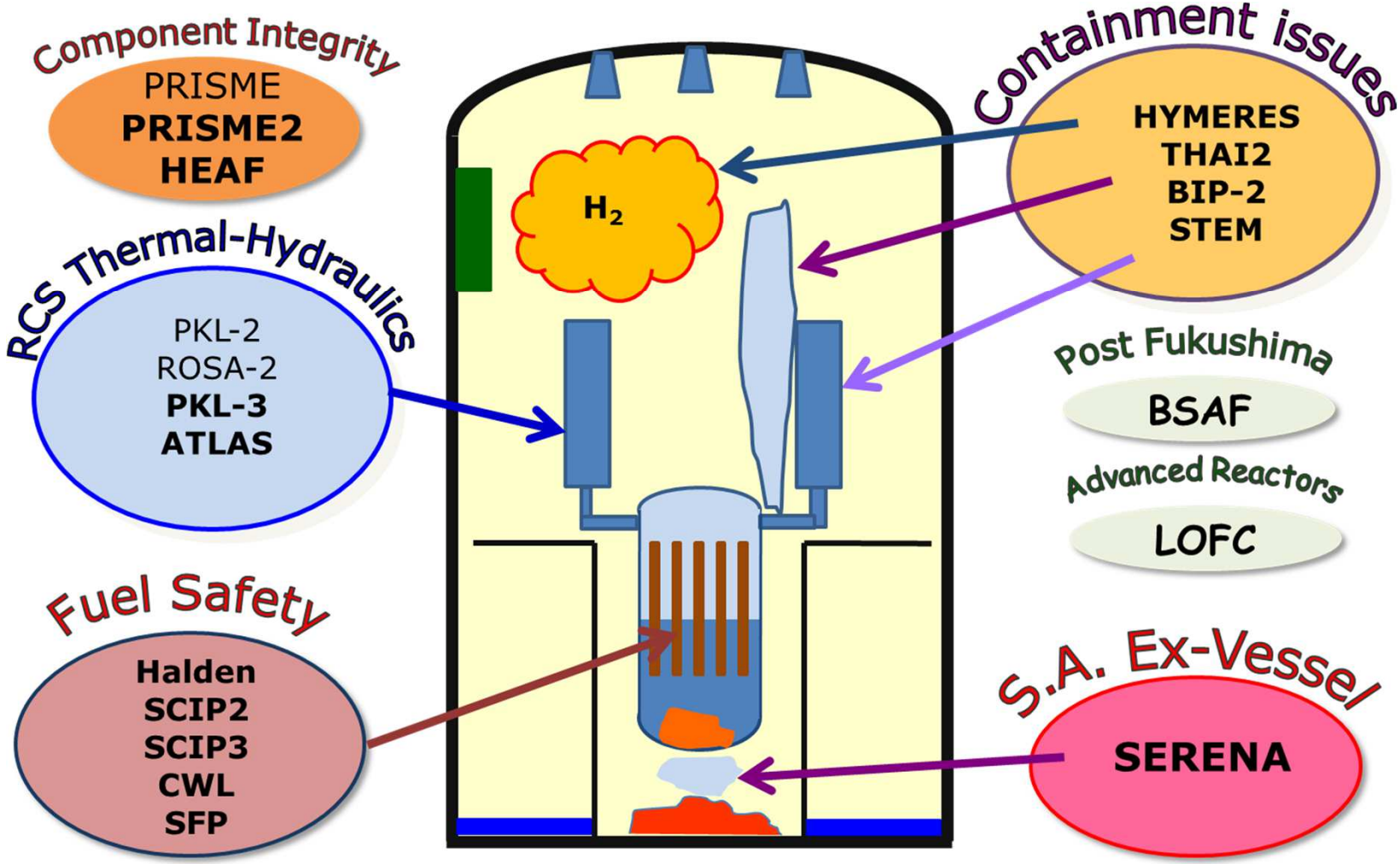


Today's Joint Safety Research Projects

HALDEN	Fuel & Materials, I&C, HOF	Norway
CABRI CWL	Fuel in RIA transients in Cabri Reactor	France
SCIP-3	Fuel integrity	Sweden (starting)
SFP	Fuel hydraulics/ignition phenomena	USA (completed)
LOFC	Loss of Forced Coolant with HTTR	Japan
PKL-3	RSC TH remaining issues	Germany
THAI-2	Containment (H2, FP,…)	Germany
HYMERES	Containment TH (CFD)	Swit/Fra
BIP-2	Iodine chemistry	Canada (completed)
STEM	Source Term Evaluation & mitigation	France
SERENA	Steam explosion	Korea & France (comp.)
PRISME-2	Fire safety	France
HEAF	High Energy Arcing Faults	USA
BSAF	Benchmark Study of Accident at Fukushima	Japan
ATLAS	Adv Therm-Hydr Test Loop for Accident Sim	Korea

- **Operational Experience Databases**:
  - **1.FIRE 2.ICDE 3.CODAP 4.CADAK**

Post 2011 OECD/NEA Safety Research Projects



Closed Joint Projects (1)

1. •OECD/NEA Rig-of-safety Assessment (ROSA-2) Project (2009-2013)
2. •OECD/NEA Sandia Fuel Project (SFP) (2009-2013)
3. •OECD/NEA Behaviour of Iodine Project (BIP) (2007-2011)
4. •OECD/NEA Bubbler Condenser Project (1998-2002)
5. •OECD/NEA Computer-based Systems Important to Safety (COMPSIS) Project (2005-2011)
6. •OECD/NEA Fire propagation in Elementary, Multi-room Scenarios (PRISME) Project (2006-2011)
7. •OECD/NEA LOFT Project (1983-1989)
8. •OECD/NEA Material Scaling (MASCA) Project (2000-2003)
9. •OECD/NEA MASCA-2 Project (2003-2007)
10. •OECD/NEA Melt Coolability and Concrete Interaction (MCCI) Project (2002-2005)
11. •OECD/NEA Melt Coolability and Concrete Interaction (MCCI-2) Project (2006-2009)
12. •OECD/NEA Piping Failure Data Exchange (OPDE) Project (2002-2011)
13. •OECD/NEA Primary Coolant Loop Test Facility (PKL-1) Project (2004-2007)
14. •OECD/NEA Primary Coolant Loop Test Facility (PKL-2) Project (2008-2011)

Closed Joint Projects (2)

15. •OECD/NEA PLASMA Project (1998-2000)
16. •OECD/NEA PSB-VVER Project (2003-2008)
17. •OECD/NEA RASPLAV Project (1994-2000)
18. •OECD/NEA Rig-of-safety Assessment (ROSA) Project (2005-2009)
19. •OECD/NEA Sandia Lower Head Failure Project (OLHF) (1998-2002)
20. •OECD/NEA Steam Explosion Resolution for Nuclear Applications (SERENA) Project (2007-2012)
21. •OECD/NEA Studsvik Cladding Integrity Project (SCIP) (2004-2009)
22. •OECD/NEA Studsvik Cladding Integrity Project (SCIP-2) (2009-2014)
23. •OECD/NEA Stress Corrosion Cracking and Cable Ageing Project (SCAP) (2006-2010)
24. •OECD/NEA SCORPIO Project (1996-1998)
25. •OECD/NEA Sesar Thermal-hydraulics (SETH) Project (2001-2006)
26. •OECD/NEA SESAR Thermal-hydraulics (SETH-2) Project (2007 - 2010)
27. •OECD/NEA Thermal-hydraulics, Hydrogen, Aerosols and Iodine (THAI) Project (2007-2009)
28. •OECD/NEA TMI Vessel Investigation Project (VIP) (1988-1993)
29. •OECD/NEA-IAEA Paks Fuel Project (2004-2007)

Statistics observed from the NEA Joint Projects

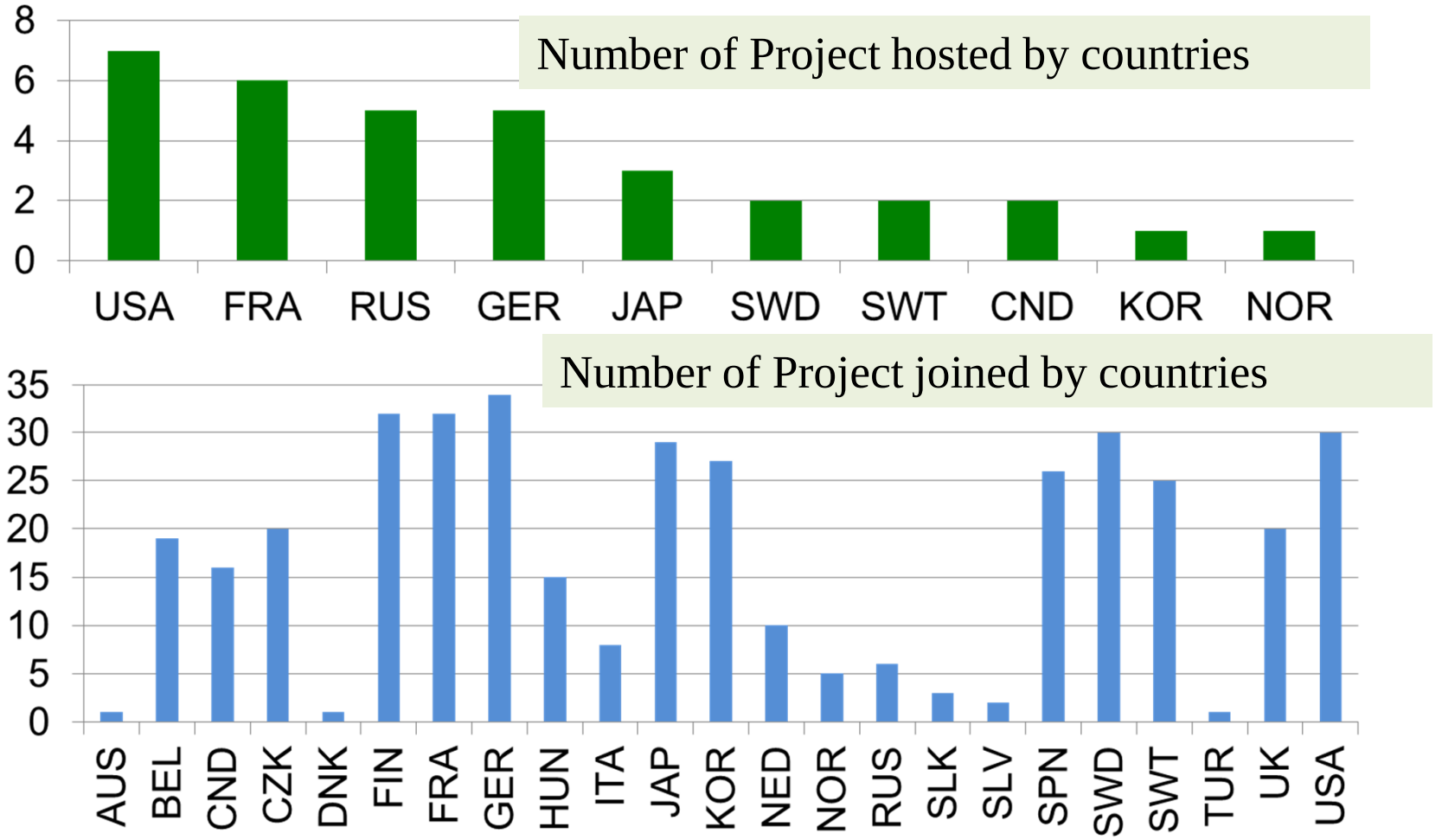
Project duration*	Years
minimum	3
average	4
maximum	6

Project budget*	M€
minimum	~1
average	~4
maximum	~9

Participants	total	Safety organisations	Research organisations	Industry
minimum	8	2	2	0
average	15	7	6	2
maximum	23	11	11	9

* Other than Halden Project , LOFT Project and Cabri Project

Projects Hosted and joined by MC's



Scope of Report and Projects that Delivered Achievements

Thermal Hydraulics (including LOCA , Boron dilution and Shut-down)

- SETH, PKL, ROSA, PRISME, PSB-VVER, LOFT

Fuel safety issues (Incl. HBU, LOCA and Reactivity Initiated Accidents (RIA))

- HALDEN, SCIP, Paks NPP, SFP, CABRI

Severe accident issues (Incl. In-vessel melt, In-vessel explosion and Accident Management)

- TMI, RASPLAV, OECD-LHF, MCCI, BIP, SERENA, THAI

Scope of Report and Projects that Delivered Achievements

Thermal Hydraulics

Greatly advanced our understanding of phenomena, strengthened the data base for validation of system codes and CFD codes, and contributed to the resolution of safety issues

Fuel safety issues

Addressed safety-significant issues: Power uprates, higher burn-up, new fuel element designs and new cladding materials. Thorough understanding of phenomena and failure mechanisms strengthen the technical basis for a possible revision of acceptance criteria

Severe accident issues

Contributed to knowledge about severe accident phenomena, the resolution of many questions related to severe accidents and accident management measures (features and procedures) to terminate or mitigate the accident progression.

Joint projects: Working Together

Sharing experimental infrastructure

- Cost saving by putting resources together.
- It helps the host country to maintain the facility
- Data to support independent safety assessment of partners
- Experimental know-how

Procedure for establishing and conducting a Project

- The Halden Project (1958) had a pilot function for establishing and managing a successful international project in reactor safety.
- In 2002, general guidelines for initiating, financing and managing projects were issued, leaving a large degree of flexibility to the individual project; these guidelines have led inter alia to a standard form of Agreement.
- NEA plays an essential role in the initiation phase and keeps helping the Project throughout its lifetime by giving administrative, advisory and technical support.

Joint projects: Working Together (2)

Identifying priorities

- In the 1990s Senior Groups of Experts on Safety Research (SESAR) were charged with identifying research priorities and issuing recommendations for CSNI action.
- Now project proposals reference the Technical Goals identified in the CSNI or CNRA Operating Plans I.e. Member Countries define their priorities.

Building consensus

- A common data base is of high value; the common recognition that the data is relevant for the phenomena and safety topic under consideration is an additional value and a necessary step for building consensus.
- Findings from a JRP might be reflected in a State-of-the-Art Report covering a wider area of safety topics or even form the basis of a Technical Opinion Paper or part of an international Standard Problem (ISP)

Joint projects: Working Together (3)

Recognising the benefit of Joint Research Projects

- JRPs have generated safety relevant programmes that would have never happened if the individual countries were left alone with maintaining and operating a large facility.
- In terms of resolving a safety issue "for good" - For most safety issues, experimental research is often an essential part of the solution. JRPs create cross fertilisation of ideas and drive thinking
- The time scale of JRPs including preparation, contract building, programme execution, data treatment, and reporting takes typically several years. Therefore, JRPs are mostly useful for dealing with mid-term or long term issues.
- A new generation of experts has taken over. New countries come into the nuclear arena. JRPs have a large capability for know-how transfer and for building expert capacity.

Summary Conclusion of the Projects Report- (1)

- The NEA platform provides an opportunity for countries to share the cost of generating data and information to resolve safety issues.
- The NEA platform brings together the world's leading experts who contribute to maintaining and improving expertise and tools in member countries, to enhancing technical exchange among specialists, and to promoting consensus building on approaches to resolve safety issues.
- Thus, JRPs make a significant contribution to knowledge management.

Summary Conclusion of the Projects Report - 2

- Analytical activities dealing with data interpretation, model development and code validation run in parallel with the projects constitute an additional benefit of the Joint Research Projects.
- JRPs are responding to the challenges in all safety-relevant areas. Thorough understanding of phenomena associated with accidents strengthen the technical basis for safety decisions.
- Any new Project should carefully consider the lessons learned from recent operating experience including reported events and accidents.

Continued Development
NEA Joint Nuclear Safety Projects

Post-Fukushima related Research Work

- BSAF (Japan)- Benchmark Study of the Accident at the Fukushima Daiichi Nuclear Power Station Project
- HYMERES (France / Switzerland) - Hydrogen Mitigation Experiments for Reactor Safety
- PKL3 (Germany/ Hungary / Finland) - PWR Transient Tests Under Postulated Accident Scenarios
- ATLAS (Korea) - Advanced Thermal-Hydraulic Test Loop for Accident Simulation

SAREF will generate further research projects related to the decommissioning of the Fukushima Daiichi Facility

2015 Project Membership

- Now includes China , India, UAE
- Open to accession by Governments of OECD/NEA Member countries or bodies designated by such Governments, or OECD non-member countries or economies in compliance with the rules and regulations applicable to the OECD
- If a project is in existence this is qualified by the requirement that there is unanimous approval of the Project's Management Board and subject to any conditions that it might determine.

Projects Considering Extension

- THAI2 – Collaborative Partnership with German THAI programme plus collaborative mutual benefit work with partners outside the NEA
- BIP and STEM – Possible combination model of a collaborative partnership of two Operating Agents (OA) and a common theme that facilitates internal counterpart testing
- PKL3 – Already a multi-OA model involved in counterpart testing and scaling
- PRISME – Considering a collaborative partnership with another OA

Concluding Thoughts

The existing OECD/NEA framework for Joint Nuclear Safety Research projects shows that there is strength and effectiveness in:

- International collaborative projects between Countries
- International collaborative projects between Operating Agents
- Counterpart testing
- Sharing of Challenges and Successes as well as the burden of Cost
- Growing and transferring knowledge and know how

Finally

NEA wishes the meeting every success in exploring the subject of Strengthening Research and Development Effectiveness

and

looks forward to adding any new insights or topics into its existing and future Joint Nuclear Safety Projects

International nuclear safety research

NEA CSNI/CNRA Committee web page:

- http://www.oecd-nea.org/nsd/

NEA Joint projects web page :

- http://www.oecd-nea.org/jointproj/

Completed “Joint Projects” data (after 3 years):

- http://www.oecd-nea.org/dbprog/