

7th Review Meeting of the Convention on Nuclear Safety



SWEDEN

Country Group 2

National Report Presentation

Vienna, March 31, 2017

Presentation Outline

(1)

- Summary of Basic Information on the National Program
- Changes in the National Program since the last Review Meeting
- Safety Improvements for existing Nuclear Power Plants
- Response to the Challenges of the 6th Review Meeting
- Response to the Suggestions of the 6th Review Meeting
- Response to International Peer Review Missions results
- 6th Review Meeting Special Rapporteur Challenges
- Vienna Declaration (Principles 1 – 3)
- Vienna Declaration (Application)

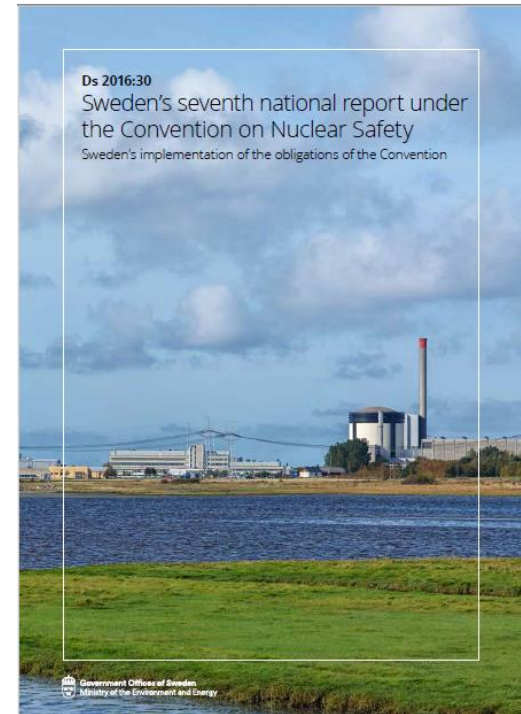
Presentation Outline

(2)

- Fukushima follow-up since the 6th Review Meeting
- Current and Future Challenges
- Good Practices and Areas of Good Performance
- Questions Raised from Peer Review of National Report
- Updates to National Report to 7th Review Meeting
- Conclusions

The Swedish National Report

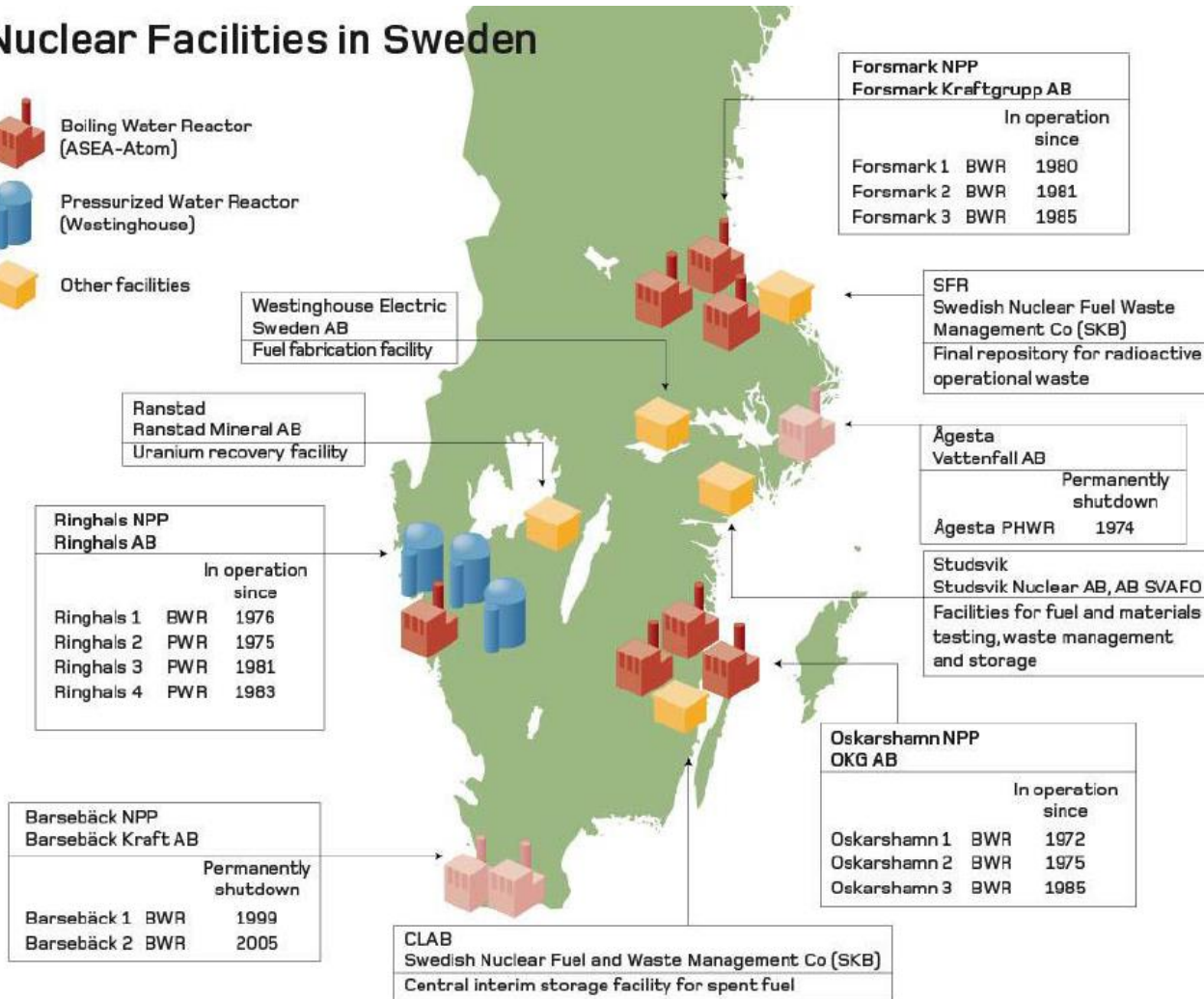
- The Report was submitted within the defined timeframe
- Answers to questions received were posted within the defined timeframe



The Swedish Nuclear Programme

(1)

Nuclear Facilities in Sweden



The Swedish Nuclear Programme

(2)

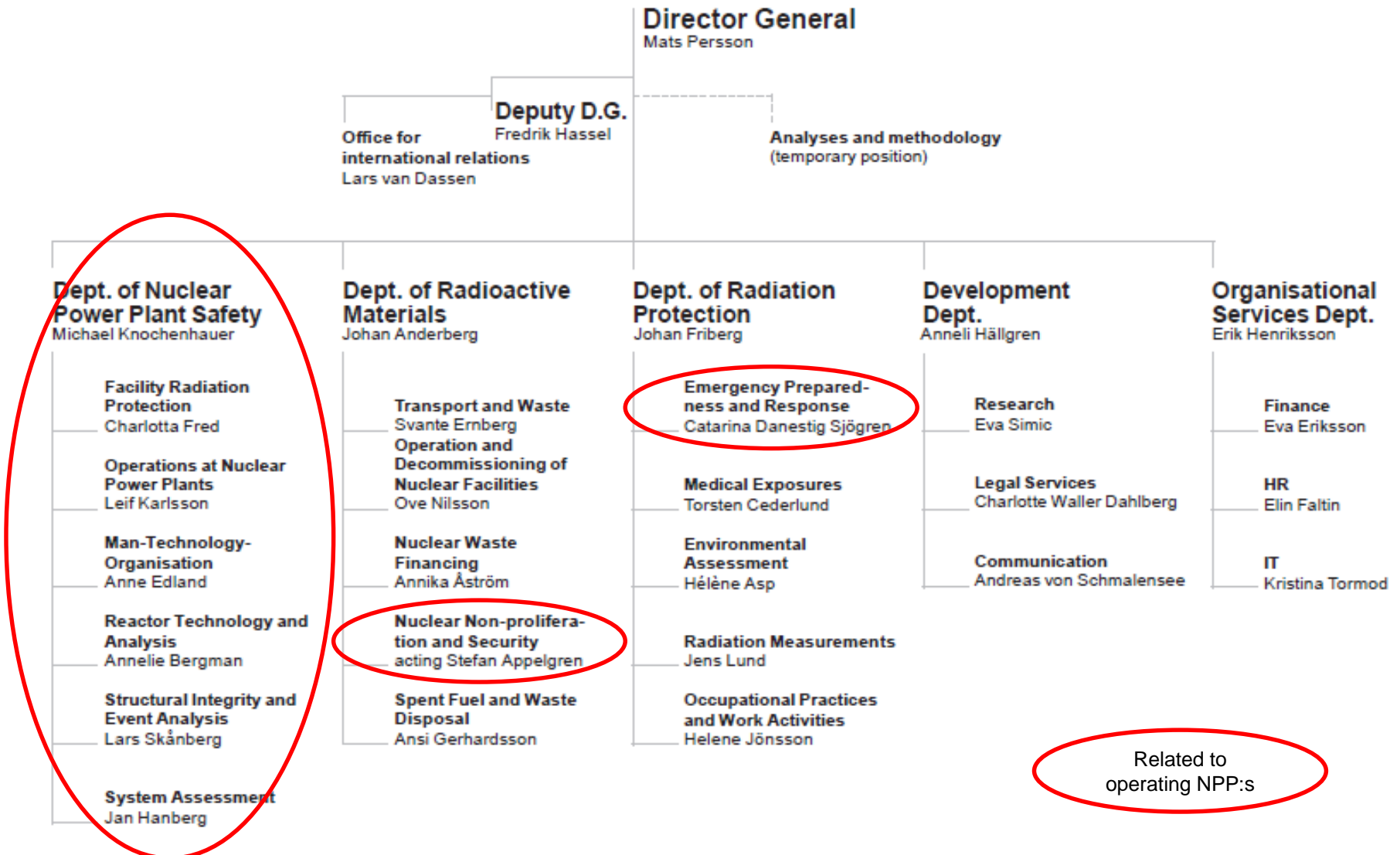
Power reactor	Licensed thermal power level (BMW)	Electrical gross output (MW)	Type	Licensee	Construction start	Commercial operation
Ågesta	105	12	PHWR	AB Atomenergi Vattenfall	1957	1964-1974
Barsebäck 1	1800	615	BWR	Barsebäck	1970	1975-1999
Barsebäck 2	1800	615	BWR	Kraft AB	1972	1977-2005
Forsmark 1	2928	984	BWR	Forsmarks	1971	1980
Forsmark 2	3253	1120	BWR	Kraftgrupp AB	1975	1981
Forsmark 3	3300	1167	BWR		1978	1985
Oskarshamn 1	1375	492	BWR	OKG Aktiebolag	1966	1972-2017
Oskarshamn 2	1800	661	BWR		1969	1975-2015
Oskarshamn 3	3900	1450	BWR		1980	1985
Ringhals 1	2540	895	BWR	Ringhals AB	1968	1976-2020
Ringhals 2	2660	910	PWR		1969	1975-2019
Ringhals 3	3144	1117	PWR		1972	1981
Ringhals 4	2783	1181	PWR		1973	1983

The Swedish Nuclear Programme

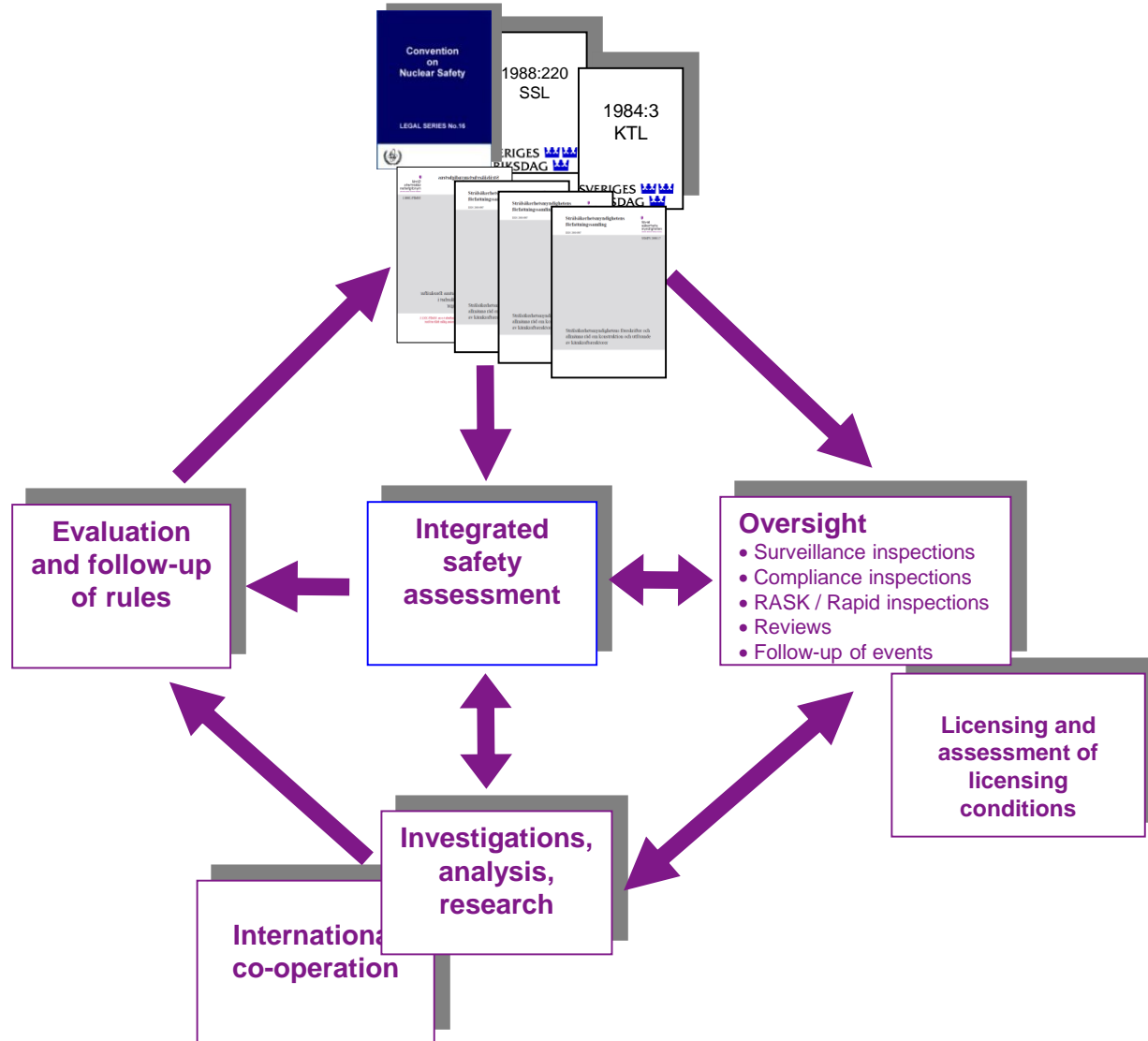
- **Ministry in charge of nuclear safety issues**
 - The Ministry of the Environment and Energy

- **Independent regulatory body to deal with nuclear safety issues**
 - The Swedish Radiation Safety Authority (SSM)
 - Reports to the Minister of Environment
 - Staff 300
 - Budget 500 MSEK (\approx 55 M€)

The Swedish Radiation Safety Authority

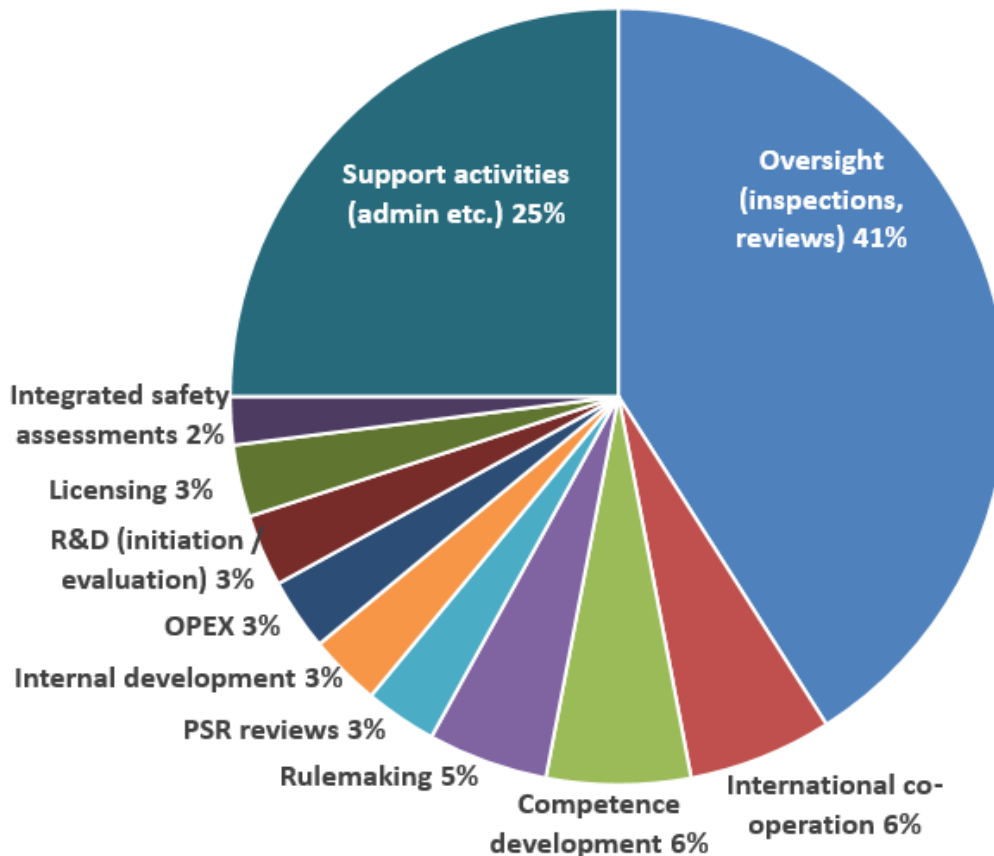


SSM regulatory functions

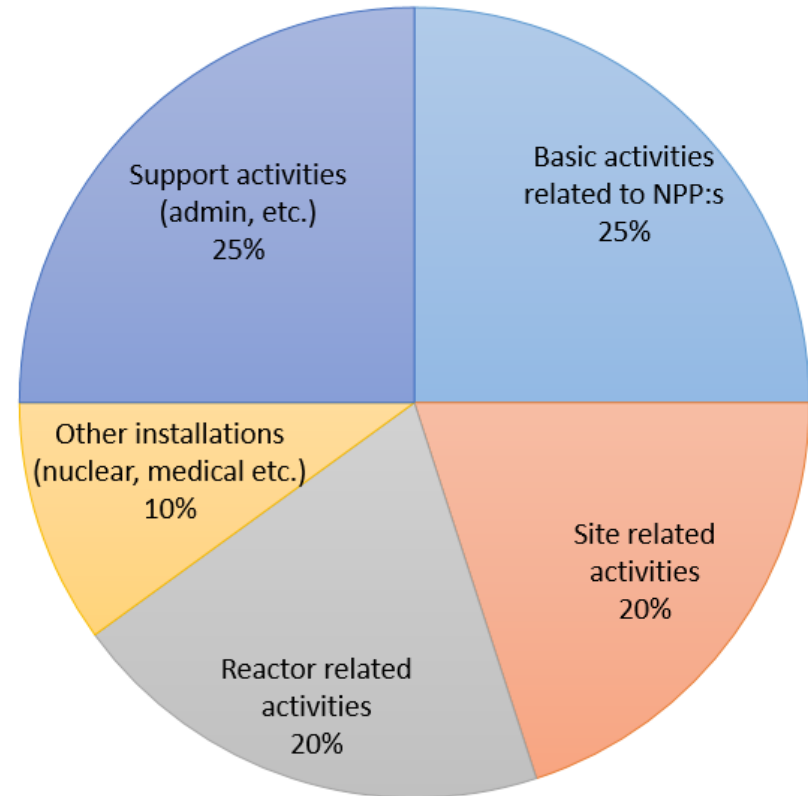


Distribution of activities performed by SSM

The work consists of...



The work relates to...



Changes since the 6th Review Meeting (1)

■ **New regulations**

- SSM has issued new regulations concerning emergency preparedness at nuclear facilities (SSMFS 2014:2)

■ **Transposition of two EU directives into Swedish legislation**

- Amended Nuclear Safety Directive (2014/87/EURATOM)
- Basic Safety Standards (BSS) for radiation protection (2013/59/EURATOM)

■ **A major review and update of SSM's regulations is on-going since 2013**

- 15-20 person years each year
- The main NPP related regulations are currently being prepared for final consultation

Changes since the 6th Review Meeting (2)

■ National contingency plan for nuclear accidents

- Compiled in 2014–15
- Describes basic conditions such as legislation, organizations involved, responsibilities and coordination in the event of a nuclear emergency

■ Radiation protection

- Focus on reducing doses to the most exposed workers has continued with a positive effect
- Efforts to reduce releases of radioactive substances to air and water have been effective
- Radiation protection education and training at NPPs strengthened
- New monitoring stations providing information on dose rates at 90 locations around the Swedish NPP:s

Changes since the 6th Review Meeting (3)

■ Changes at the Licensees

- The extensive modernisation programmes introduced in 2005 for all Swedish NPP:s was completed in 2016 (regulation SSMFS 2008:17)
 - The modernisation programme has resulted in major safety enhancements by improving
 - physical and functional separation / resistance to internal hazards
 - diversification of safety functions / resistance to common case failures
 - accident management measures
 - resistance to external hazards
- Power uprate programmes in final stages for three units; trial operation on-going at increased power levels
- In late 2014 activities related to plans to build new nuclear reactors were put on hold and there is currently no intention to resume the project

Changes since the 6th Review Meeting (4)

■ Changes at the Licensees

- During 2015 decisions were taken by owners and licensees to phase out the four oldest nuclear power reactors during the period 2017 – 2020
 - The licensees are subject to *increased oversight* starting from the day of the decision and lasting at least until phase-out:
 - Sufficient personnel/competence to safely operate and decommission
 - Internal communication
 - Leadership in change
 - Motivation of staff and reaction to uncertainty
 - Maintenance, investments and development kept at sufficient level to assure adequate safety
 - Organisational changes at licensee including interaction with majority owner

Safety Improvements for existing Nuclear Power Plants (1)

- **Modifications and backfitting**
 - Measures included in the modernization programs for existing nuclear power reactors, initiated in 2005, were completed 2016
- **Assessments based on the NAcP have been carried out and implementation is under way**
 - Regulatory review is ongoing
 - Implementation of measures is proceeding at all NPPs
- **Re-assessments of the robustness of electrical power supply**
 - Ongoing based on experiences from national and international events indicating a need for a more rigorous approach to electrical system design

Safety Improvements for existing Nuclear Power Plants (2)

■ Strengthening core cooling capability

- In 2014 SSM requested all Swedish nuclear power reactors operating after 2020 to have an additional fully independent core cooling system in place before 2021.
 - Prevention of core damage for extreme events previously not included in the design basis.
 - Protection of the plant against events leading to the extended loss of normal core cooling function.
 - Required to be designed to cope with
 - Extended Loss of AC Power (ELAP) ≥ 72 h
 - Loss of normal access to Ultimate Heat Sink (LUHS) ≥ 72 h
 - Extreme external events with frequency $\geq 1E-6$ /year
 - Two stage implementation
 - Temporary safety measures (“considerably improving independence”) shall be implemented in 2017
 - Robust permanent system shall be implemented in 2020

Response to the Challenges of the 6th Review Meeting (1)

- **CH-SE-1 / To manage the Vattenfall AB application for replacing one or two old reactors by new ones (closed)**
 - Preparation for licensing not ongoing as plans for new build of nuclear reactors have been put on hold
- **CH-SE-2 / The review of SSM's regulatory framework, i.e. regulations and general advice, for nuclear and radiation safety (in progress)**
 - A major review of SSM's regulations was initiated in 2013 and is on-going

Response to the Challenges of the 6th Review Meeting (2)

- **CH-SE-3 / The implementation of the Swedish National Action Plan (closed / in progress)**
 - Analyses / measures to improve safety w.r.t. to issues covered by the stress tests, including protection against external hazards
 - Actions related to emergency preparedness
 - Requirement regarding new fully independent core cooling system
- **CH-SE-4 / Licensees are finalizing the update of safety analysis reports in order to comply with new safety requirements (in progress)**
 - Regulator reviews performed e.g. in connection with PSR, finalisation of modernization programme, applications for routine operation after power uprates

Response to the Challenges of (3) the 6th Review Meeting

- **CH-SE-5 / Ensuring safe LTO of Swedish NPPs requires additional safety improvements and licensees applying an effective AM (in progress)**
 - Requirements on having ageing management programmes in place expressed more specifically in the new regulations
 - IAEA Pre-SALTO missions performed at Ringhals and Forsmark NPPs, and planned for Oskarshamn plant
 - Participation in EU Topical Peer Review 2017/18
- **CH-SE-6 / 9 out of the 10 reactors will be subject of LTO evaluation in the upcoming PSRs (in progress)**
 - Requirements related to PSR revised in new regulations
 - Ageing management important issue in forthcoming PSR:s
 - Focus on the six reactors remaining in operation after 2020

Response to the Challenges of the 6th Review Meeting (4)

- **CH-SE-7 / Additional challenges on safety management from extensive modernization and power uprate programmes (closed)**
 - Modernisation programmes finalised in 2016
- **CH-SE-8 / Inform on results of special supervision of Oskarshamn NPP (closed)**
 - OKG was put under special supervision by SSM in December 2012
 - SSM's findings show that OKG continued to strengthen and develop its organization during the period since 2014
 - In June 2016 SSM decided that there is no longer any need for special conditions for the operation of OKG

Response to the Suggestions of the 6th Review Meeting

- **SU-SE-1 / Ensure that SSM gets a legal basis for performing vendor inspections (closed)**
 - Suggestion reported to the Government.
 - SSM has proposed an amendment to the Nuclear Activities Act to be allowed to conduct supervision of a licensee's quality assurance at suppliers' and manufacturers' sites.
 - Government bill presented to the Parliament March 16, 2017

Response to Results of International Peer Reviews

- **IAEA IRRS mission in 2012 / follow-up in April 2016**
 - 20 recommendations out of 22 were closed
 - 9 were closed on "progress and confidence".
 - 2 recommendations remained open.
 - All 17 suggestions were closed
 - 5 were closed on "progress and confidence".
 - As a result of the follow-up mission in April 2016 four additional suggestions and two good practices were reported
 - *To be commented on later in the presentation*

6th Review Meeting Special Rapporteur Challenges

- **Minimize gaps between CP safety improvements**
 - IAEA standards, WENRA SRL, participation in OECD/NEA, MDEP, CNS, OPEX
 - **Harmonized EPR measures**
 - Bi-lateral, regional (e.g. Nordic) and international co-operation (HERCA)
 - **Making better use of experience and of peer review services**
 - Experience feedback within EU, OECD/NEA etc; Active participation in peer review services, IRRS, WANO, OSART
 - **Improving regulators' independence, safety culture, transparency and openness**
 - Internal programmes and exposure to international peer reviews
-

Vienna Declaration (Principle 1)

New nuclear power plants are to be designed, sited, and constructed, consistent with the objective of preventing accidents in the commissioning and operation and, should an accident occur, mitigating possible releases of radionuclides causing long-term off site contamination and avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions.

■ General comment

- The VDNS principles are addressed in the amended EU Nuclear Safety Directive 2014/87/EURATOM (transposition ongoing)
- Update of legislation and SSM regulations is ongoing

■ Sweden has no new reactor in the sense of the VDNS

- An application was submitted by Vattenfall AB in July 2012 and put on hold in late 2014
- The licensing of a new NPP would be conducted in accordance with new legislation and regulations
- Thus, any new reactor would fulfil the principles of VDNS

Vienna Declaration (Principle 2)

(1)

Comprehensive and systematic safety assessments are to be carried out periodically and regularly for existing installations throughout their lifetime in order to identify safety improvements that are oriented to meet the above objective. Reasonably practicable or achievable safety improvements are to be implemented in a timely manner.

■ Periodic Safety Reviews

- Performed since the 1980's (originally ASAR; As-operated Safety Analysis Review)
 - Current PSRs are the fourth series of 10-year reviews
- Affected by amended EU NSD 2014/87/EURATOM, and included in updated Swedish legislation and SSM regulations
- The PSR shall provide an over-all view on safety and identify needs and possibilities to improve safety further
- The conclusions are put into an action plan

Vienna Declaration (Principle 2)

(2)

■ Level of safety is assured and improved

- Safety improvements are identified through analysis of operational experience, research and development, evaluation of new knowledge
- Sweden applies the concept of “Living PSA” which means that the PSAs are up to date and continuously used in enhancing and understanding plant safety status. PSAs are required to include levels 1 and 2, all IE categories, all operating states
- R&D, new knowledge and technology change affects what is reasonable and justifiable over time
- This is basically a continuous adaptation to the concepts “acceptable level of safety” and “reasonable and justifiable”
- Risk informed approaches can be used to support assessments

Vienna Declaration (Principle 2) (3)

- **The principles of the Vienna Declaration will also be covered through the planned update of the Nuclear Activities Act (implementing the amended EU Nuclear Safety Directive Euratom 2014/87)**
 - According to Government decisions from the 1980s, large releases and long-term contamination of soil shall be prevented
 - Starting in the 1990's further major safety upgrades were required for all operating reactors (current regulations SSMFS 2008:1, SSMFS 2008:17)
 - The Nuclear Activities Act requires an overall assessment of a nuclear facility's safety and radiation protection (PSR) to be conducted at least every ten years

Vienna Declaration (Principle 2)

(4)

- **Prevention of accidents addressed by e.g.**
 - Strengthening of DiD and independency between DiD levels
 - Addressing Design Extension Conditions
 - Avoidance of high pressure core melt scenarios
 - Use of detailed PSA models to verify low core-melt frequencies
 - Design basis further reviewed in connection with EU stress tests
 - Requirement to install a fully independent core cooling system

Vienna Declaration (Principle 2)

(5)

- **Mitigation of accidents and avoiding releases causing long-term off-site contamination addressed by e.g.**
 - Filtered containment venting system with decontamination factor of at least 500
 - Independent containment spray system
 - Automatic filling of lower drywell with water (some BWR:s)
 - Containment pressure relief in events of LOCA and degraded PS function (BWR)
 - Containment instrumentation qualified for severe accidents (activity, temp., pressure, water level, hydrogen content)
 - Follow up and evaluation of new research results and experiences (APRI programme on-going since 30 years)

Vienna Declaration (Principle 2)

(6)

- **Severe accident management guidelines, protection of staff during an accident**
 - SAMG or similar are in place
 - Main control room and command and control centre are equipped with filtered air intakes and self-circulating mode
- **Provision and flexibility of Emergency Mitigation Equipment (EME)**
- **Implementation of on-line transmission to SSM of crucial plant data in connection with an emergency (ETAPP project)**
 - Recent co-operation project between SSM and the licensees
 - Agreement on MMI interfaces, parameters to follow and technical solution

Vienna Declaration (Principle 3)

National requirements and regulations for addressing this objective throughout the lifetime of nuclear power plants are to take into account the relevant IAEA Safety Standards and, as appropriate, other good practices as identified inter alia in the Review Meetings of the CNS.

- **Swedish national requirements are developed in consideration of relevant IAEA Safety Standards, WENRA reference levels, as appropriate, and other good practices**
 - In SSM's management system, it is stated that IAEA Safety Standards shall be reflected in SSM regulations
 - Applied in the ongoing process of preparation of a new set of regulations
 - A corresponding recommendation was received in the 2012 IRRS, and closed based on progress and confidence at the IRRS Follow-up in 2016

Vienna Declaration (Application)

- **Based on EU stress tests no urgent issues were identified related to the VD principles**
 - The early introduction of filtered venting systems and accident mitigation measures as well as on-going modernisation projects were positive aspects in this respect
 - The stress tests and the resulting national action plan resulted in a number of additional analyses and actions
 - Dependence of core cooling on electric power supply in case of SBO or emergency; this was known to be an important issue and already under discussion before the Fukushima accident

Fukushima Follow-up since the 6th Review Meeting

(1)

- **Actions covered by the EU stress test National Action Plan**
 - In 2016 licensees submitted to SSM plant-specific implementation plans for measures identified by the evaluations and analysis covered by the NAcP
 - Focus on strengthening the plant's protection against extreme external hazards and improving emergency preparedness and response
 - Measures to further strengthen the safety of the plants, identified by the evaluations and analysis are required to be completed by 2020

Fukushima Follow-up since the (2) 6th Review Meeting

- **Increasing the reliability of the core cooling systems in a NPP**
 - Discussions regarding the introduction of a new and functionally independent core cooling system started already around year 2000
 - Protection during events leading to loss of normal core cooling functions due to extreme external influence such as e.g.
 - Extended loss of all AC voltage
 - Extended loss of ultimate heat sink
 - License condition was issued for all operating nuclear reactors in 2014. Two stage implementation 2017 / 2020
 - Licensees required to present detailed implementation plans

Current and Future Challenges

(1)

- **Maintaining national competence in the medium and long-term**
 - Relates to the need to ensure the long-term availability of qualified experts in nuclear safety and radiation protection
 - The challenge applies to both the industry and regulatory authority
 - Present situation with the planned shutdown of four reactors out of ten may have an impact on the national availability of expertise, both directly and indirectly (basic education, R&D)
 - Additionally there is a need to build up and strengthen the technical and radiological competence related to decommissioning
 - *2017: Government assignment to investigate status, challenges and long-term needs related to national competence*

Current and Future Challenges

(2)

■ Transition from operation to decommissioning

- Safety culture may be challenged both short-term in connection with permanent shut-down and later during transition to decommissioning
- Strengthening regulatory activities in the area of decommissioning

■ Ensuring safe long-term operation

- Need for additional safety improvements
- Need for licensees to apply an effective ageing management

■ Finalisation of the planned complete set of regulations

- In addition to the changes required in the short term by EU directives and WENRA SRL:s

Good Practices and Areas of Good Performance

- **The following are offered as candidates for Good Performance**
 - Development of the legal framework in an extensive and focused effort addressing EU directives as well as state-of-the art requirements from IAEA, WENRA etc.
 - Finalisation of an extensive reactor modernisation programme bringing the reactor fleet in line with modern safety requirements
 - Inclusion of an early intermediate step in the requirement to install a fully independent core cooling system by 2020. The intermediate (compensatory) requirement is to considerably increase the independence of core cooling by 2017
 - Efficient co-operative approach to implement on-line transmission to SSM of crucial plant data in connection with an emergency (ETAPP project)

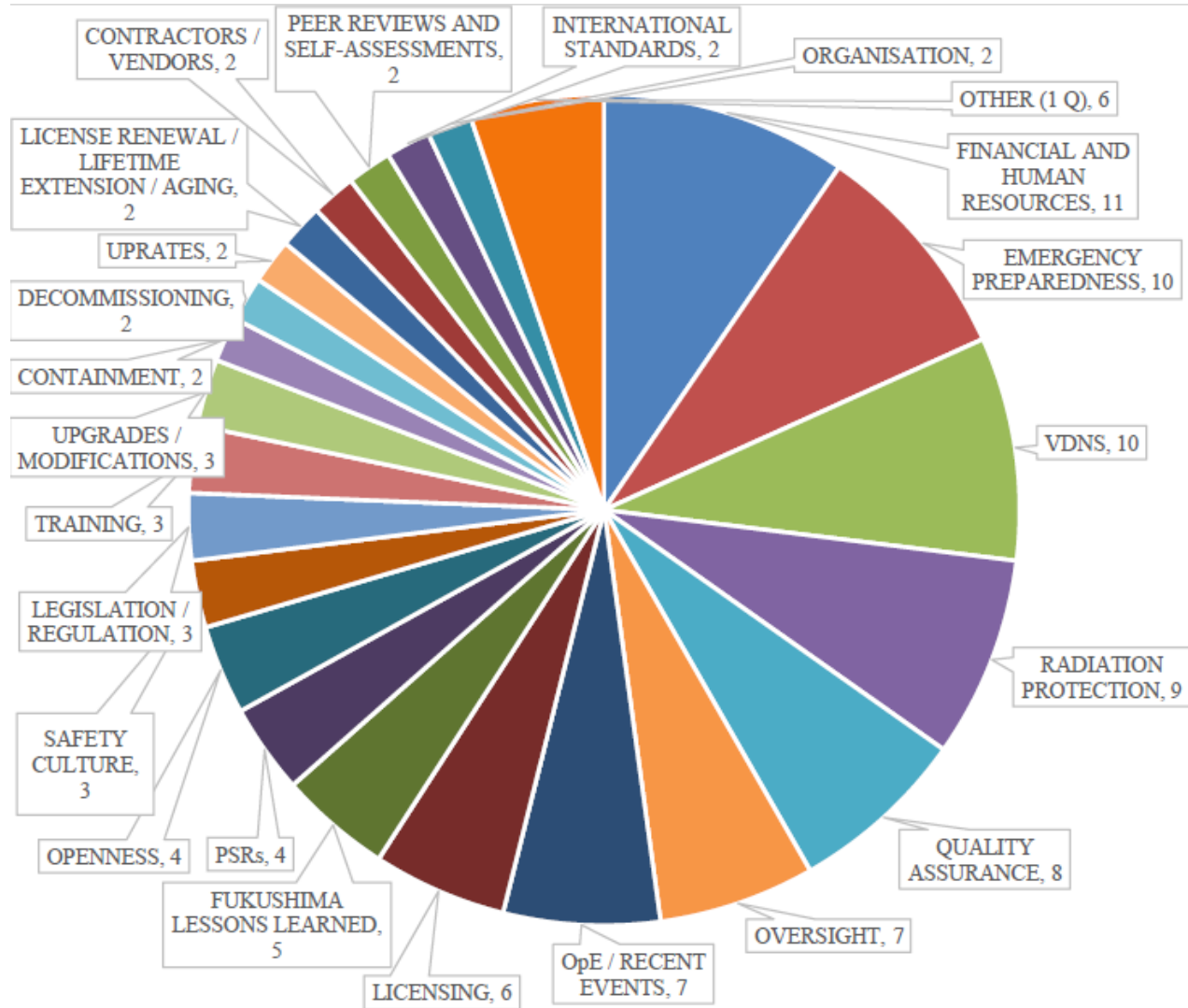
Questions and Comments from Peer (1) Review of National Report

115 Questions & 1 Comment from 20 countries

■ Belgium	9	■ Spain	12
■ Netherlands	12	■ Germany	3
■ India	3	■ Switzerland	8
■ Pakistan	3	■ Hungary	5
■ United Arab Emirates	5	■ Poland	2
■ Russian Federation	5	■ Japan	3
■ Slovakia	13	■ Montenegro	2
■ Finland	9	■ Korea, Republic of	6
■ Slovenia	5	■ Portugal	2
■ France	6	■ United States of America	2

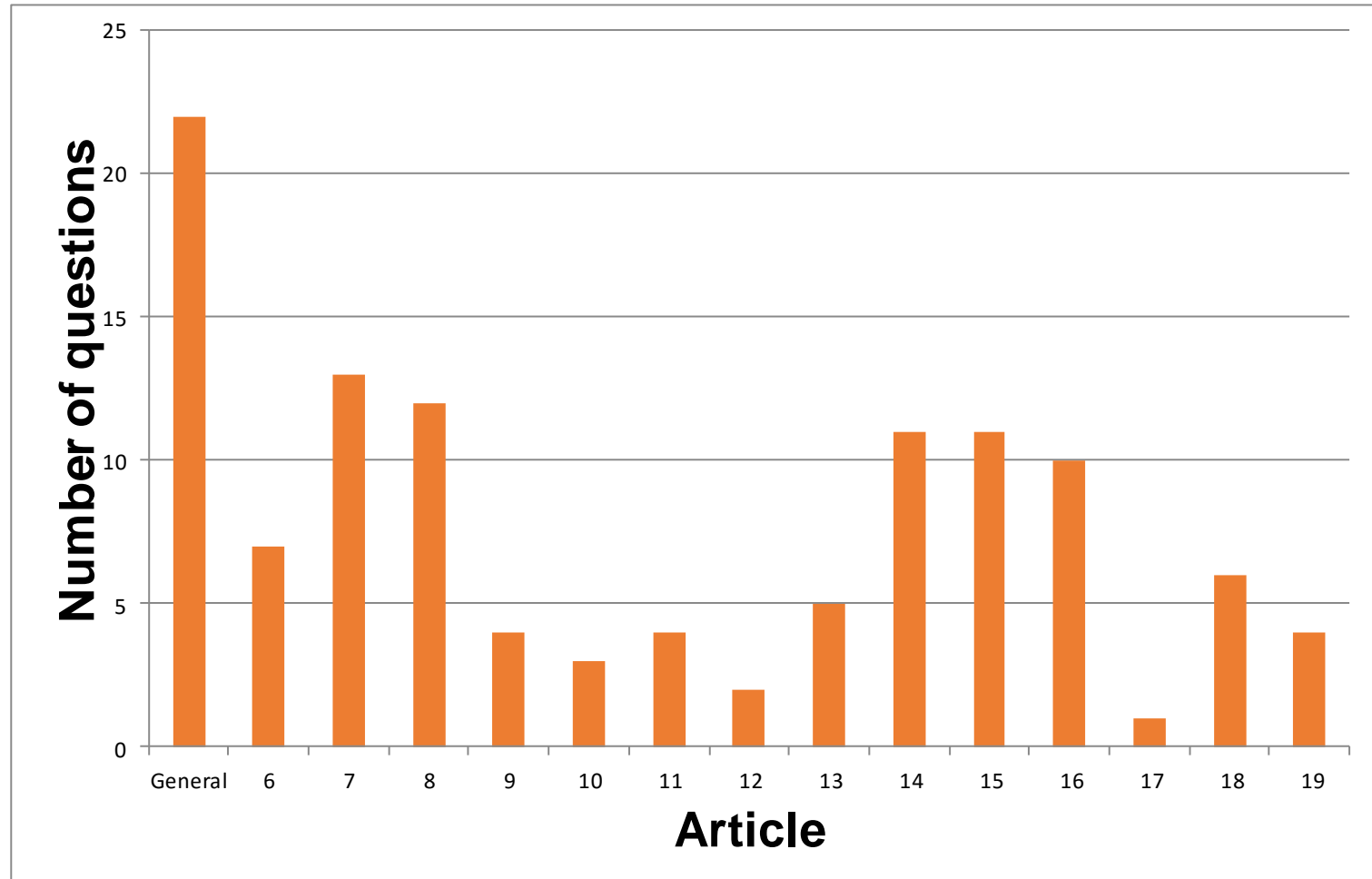
Questions and Comments

(2)



Questions and Comments

(3)



Some Questions with Safety Significance

- 7th Peer Review of the Swedish Report

■ General

- .. continued availability of human, financial & technical resources (R&D support) till safe completion of phase out / decommissioning – 2 IND, 9 NL

■ General

- .. how do your national requirements and regulations address the application of the principles and safety objectives of the Vienna Declaration – 6 NL, 13,14,15, 16, 17, 18, 19, 20 CH

■ Article 6, 36, 37

- Reactor scram caused by seawater leakage into the reactor building – 24 SLK, 26 SLO
- Corrosion in the bottom part of containment liner - 25 SLO

Some Questions with Safety Significance

- 7th Peer Review of the Swedish Report

■ Article 8, 72, 82

- Knowledge transfer and management – 50 FRA, 51NL, 54 SLK
- Results of IRRS Follow-up mission – 4 NL, 47 USA

■ Article 14, 120

- Monitoring of the various levels of safety review performed by licensees - 76, 77, 78 ES

■ Article 15, 136

- Updates of the dose models; annual worker dose - 89 HU, 91 NL

■ Article 16, 151

- Emergency level for internal use; emergency planning zones - 96 FIN, 99,102 SLK

Updates to National Report to 7th Review Meeting

(1)

■ Areva Creusot Forge Irregularities

- Investigations performed for both PWRs and BWRs
- Ringhals unit 3 has identified four components (steam generator tube sheets); minor deviations in documentation.
- Both licensees and SSM continue to follow the issue
- This is also part of increasing activities related to NCFSI (Non-conforming, Fraudulent, and Suspect Items)

Updates to National Report to 7th Review Meeting

(2)

- **IAEA IRRS Follow-up preformed in April 2016**
 - Additional 4 suggestions and 2 good practices are reported:
 - 2 suggestions in the field of - RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY
 - 1 suggestion in area - MANAGEMENT SYSTEM OF THE REGULATORY BODY
 - 1 suggestion in the field of - EMERGENCY PREPAREDNESS AND RESPONSE
 - Good practices in area of INSPECTION and REGULATIONS AND GUIDES
- **Government bill to the parliament 16 March 2017**
 - Transposition of amended EU NSD of Nuclear Activities Act into Nuclear Activities Act

Conclusions

- **After performing the self-assessment, Sweden concludes that it complies with the obligations of the Convention**
- **Sweden complies with the principles of the Vienna Declaration on Nuclear Safety**
- **The justifications for this conclusion are given in the National Reports and in the answers to questions posted to Sweden**
- **Sweden reaffirms its commitment to the Convention on Nuclear Safety and to the continued improvement of nuclear safety and regulation**