

**ANSN - Regional Workshop on
Safety Benefits and Challenges in
the Development of the Adoption of
Small Modular Reactors
(EVT2404165)
31 March - 4 April 2025
Daejeon, Rep of Korea**

Day 3: Wednesday, 2 April 2025

P15.Safety consideration on SMR Siting - 2

Name: Paolo Contri

Section: External Events Safety Section (EESS)

Division of Nuclear Installation Safety (NSNI)

International Atomic Energy Agency (IAEA)



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1. INTRODUCTION
2. SPECIFIC TECHNICAL CONSIDERATIONS FOR SMR SITING
3. APPROACH TO GRADING
4. THE SPECIAL ISSUE OF CLIMATE CHANGE
5. THE EESS SUPPORT TO SMR DEPLOYMENT
6. CONCLUDING REMARKS

INTRODUCTION

Introduction to SMRs

General Considerations for SMR

Graded Approach for SMR Safety

Introduction to SMRs

Definition of Small Modular Reactors (SMRs):

- Compact, factory-fabricated nuclear reactors that can be deployed incrementally.
- Designed for flexibility in location, application, and scalability.

Why are SMRs Important?

- Offer solutions for energy needs in remote locations, developing areas, and urban centres.
- Address challenges faced by large NPPs: cost, safety concerns, and site limitations.

Examples of Applications:

- Power generation, district heating, industrial use, and desalination.

Comparison with Large NPPs:

- Smaller size, enhanced safety, and lower radioactive inventory reduce overall risk.

Safety issues related to SMRs wrt. IAEA Requirements

Optimization of Protection: (*Principle 5 of SF-1*)

- SMRs' enhanced safety features and smaller radioactive inventory justify adjustments to safety requirements.
- Performance-based evaluations are preferred over prescriptive methods.

IAEA Safety Standards: (e.g. SSR-1, SSG-9 (Rev. 1), SSG-18, SSG-21, SSG-79, etc.)

- Applicable to all nuclear installations, including SMRs, research reactors, and fuel cycle facilities.
- Emphasize a **graded approach** for smaller or less hazardous installations.

Hazard Screening and Categorization:

- Conservative screening process tailored to SMR-specific risks.
- Hazard levels categorized by radiological consequences: low, medium, and high.

Graded Approach for SMR Safety

Key Elements of the Graded Approach: (*c.f. Para. 4.5 of SSR-1*)

- Amount and type of radioactive inventory.
- Intrinsic hazards (e.g., chain reactions, chemical processes).
- Need for active safety systems or operator actions.
- Potential on-site and off-site consequences.

Tailored Data Collection and Analysis:

- Simpler methods and smaller databases may be sufficient for SMRs.
- Balance reduced data with increased safety margins for uncertainties.

Technical issues related to siting and design of SMRs in relation to EEs

External Hazard related issues for SMRs

Siting

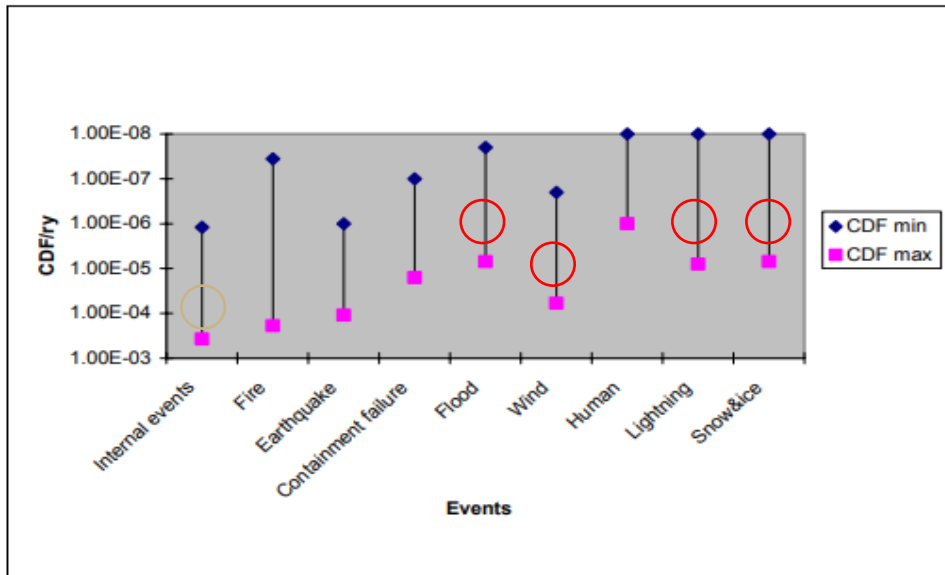
- SMRs are typically certified with “standard” EE design basis, but the site license should refer to a **site specific** assessment, requiring dedicated site investigation and hazard assessment
- SMR siting is not compatible with costs and time typical of NPP siting: a suitable **graded approach** should be applied
- The graded approach cannot be based on power inventory: reference to the **safety features** of SMRs should be applied
- **Screening** of EEs may take advantage of the special configuration of SMRs
- **Off site emergency planning** may take advantage of SMR design features
- **Multi Unit interaction** should be addressed since siting and design phases
- Interactions with **co/located facilities** should be addressed
- **Capacity building for Regulators** in site licensing is important

Design

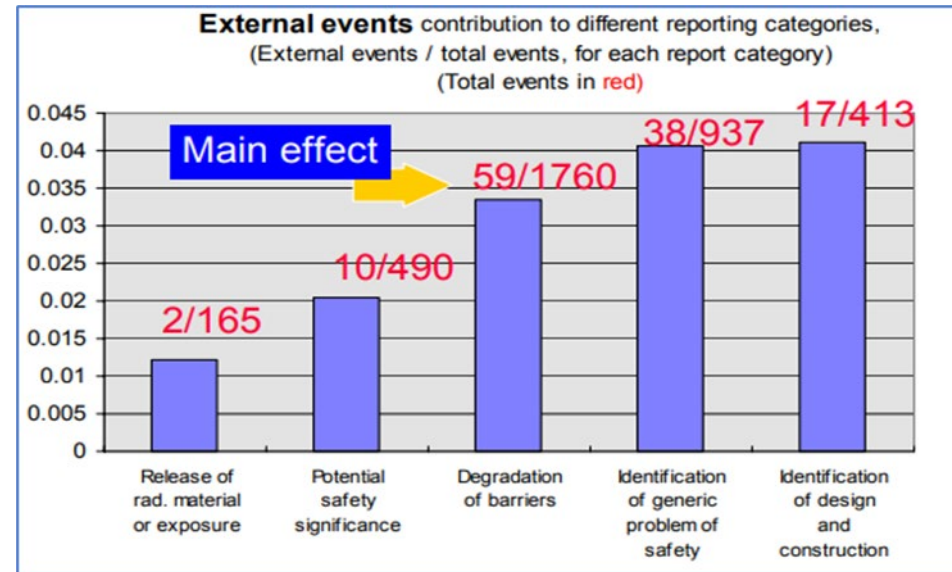
- **EE safety margins** should be reassessed with reference to actual site hazards
- **Embedment, footprint and low elevation** of superstructure may show different vulnerability to EEs
- **Component qualification** to EE may be optimized following a risk based approach
- The overall risk assessment to EE may suggest simplified approach to siting and design

Challenges to plant safety from climate change

Very significant contribution is expected by climate-change related scenarios on CDF and safety significant scenarios



US/NRC, Perspectives gained from the individual plant examination of external events (IPEEE) programme, NUREG-1742, NRC, Washington, April 2001



IAEA, Tecdoc 1341, Extreme external events in the design and assessment of nuclear power plants, March 2003 – A new assessment of external events in the period 2000-2020 is in progress at EESS

Effects of climate change affected scenarios are quite similar and relevant among all plant types. Preliminary studies show that similar impact is expected for **SMRs**

SPECIFIC TECHNICAL CONSIDERATIONS FOR SMR SITING

Geography and Demography

Human-induced External Events

Hydrology

Meteorological and Rare Events

Geological, Seismological, and Faulting Hazards

Geotechnical and Volcanic Hazards

Site-Related Issues in Radiological Impact to the Region and
Emergency Preparedness and Response

Monitoring and Instrumentation

A possible Approach for Grading Site Evaluation- based on
Consequence Analysis

Geography and Demography

Population Data:

- Smaller external zones for SMRs compared to large NPPs.
- Depends on the number of modules and assumption of single-module failure.

Emergency Response Planning:

- Assess infrastructure for sheltering, evacuation, and communication.
- Link demographic data to emergency preparedness zones.

Infrastructure and Hazard Screening:

- Include roads, ports, hazardous facilities, and mobile/stationary hazard sources.
- Screening distances depend on accident potential and SMR design resilience.

Human-induced External Events

Transportation Hazards:

- Hazards from railways, highways, and sea routes must be evaluated.
- Screening distances for SMRs may be larger than for large NPPs due to reduced robustness to loads like blast or impact.
- Embedded designs for SMRs can reduce missile impact risks.

Industrial Hazards:

- Nearby facilities pose risks from fire, explosions, hazardous gas releases, and missile generation.
- Review safety margins considering SMR design differences (e.g., thinner walls).

Aircraft Crash Risks:

- Large NPPs account for deliberate aircraft crashes; SMRs' smaller size reduces accidental crash likelihood.
- Marine-based SMRs may be more exposed, requiring special assessments.

Hydrology

Ultimate Heat Sink (UHS):

- UHS requirements differ significantly for SMRs and large NPPs.
- Some SMRs employ **passive cooling systems**, reducing reliance on active measures.
- Graded data collection and protection requirements based on UHS design.

Flooding Hazards:

- Flash floods must be evaluated, even for inland SMRs.
- Marine-based SMRs face coastal risks (e.g., tsunamis, storm surges).
- Protective measures like sea walls may be required, though cost-prohibitive.

Effluents in the Hydrosphere:

- Liquid waste characteristics vary between SMRs and large NPPs.
- Graded assessments for hydrology and hydrogeology are applicable.
- Marine-based SMRs focus on marine ecosystem impacts, not groundwater studies.

Meteorological and Rare Events

Extreme Meteorological Conditions:

- Includes high winds, extreme temperatures, heavy precipitation, and snowpack.
- Smaller SMR footprints may reduce vulnerability.

Rare Events:

- Examples: Lightning strikes, tornadoes, hurricanes, waterspouts.
- Graded evaluation helps balance risks with design resilience.

Implications for SMR Design:

- Smaller structures and modular designs can lower vulnerability to wind loads and snow accumulation.
- Coastal SMRs must consider extreme weather events, such as hurricanes and storm surges.

Geological, Seismological, and Faulting Hazards

Vibratory Ground Motion Hazard:

- Seismic hazards require thorough analysis for all nuclear installations.
- Probabilistic Seismic Hazard Analysis (PSHA) must account for:
 - Geological and seismological uncertainties.
 - Variability in seismic source and ground motion models.
- SMRs can use graded approaches to simplify PSHA while maintaining conservatism

Fault Displacement Hazard:

- Considered a potentially exclusionary hazard.
- Graded criteria are not applicable—treated the same as large NPPs.

Implications for SMR Design:

- Smaller and modular designs may reduce seismic impact risks.
- Passive safety systems in SMRs reduce potential for cliff-edge effects during seismic events.

Geotechnical and Volcanic Hazards

Geotechnical Hazards:

- Examples: Liquefaction, subsidence, slope instability, soil collapse.
- Multi-module sites face higher risks of common cause failures (e.g., landslides).
- Safety Margins for Multi-Module Sites:
 - Require higher geotechnical safety margins than single-module NPPs.
 - Review slope stability and soil improvement measures for potential cliff-edge effects.

Volcanic Hazards:

- Exclusionary aspects (e.g., lava flows, pyroclastic events) are treated as per large NPP guidelines.
- Screening distances may differ due to reduced robustness of SMR designs.

Site-Related Issues in Radiological Impact to the Region and Emergency Preparedness and Response

Key Considerations:

- Emergency arrangements depend on the size of the external zone.
- Smaller external zones are possible for SMRs, assuming limited radiological impact, or justifying with performance-based criteria.

Potential Impediments:

- Potential radiological effects on the local population and environment.
- Dispersion of radioactive material in the atmosphere and hydrosphere requires detailed analysis.
- Geographic/topographic constraints affecting transportation and communication.
- External hazards (e.g., earthquakes, floods) damaging critical infrastructure.
- Concurrent hazards at co-located facilities causing cascading failures.

Monitoring and Instrumentation

Seismic and Volcanic Monitoring:

- Continuous monitoring ensures seismic hazards are within acceptable limits.
- Volcanic activity monitoring required for sites with potential threats.

Environmental Monitoring:

- Surface water, groundwater, meteorological, and radiological conditions.
- Graded approaches tied to reactor design and potential releases.

Performance-Based Monitoring:

- Tailored systems based on specific SMR needs and site conditions.

An approach to siting - Grading

General Estimation of Site Related Costs

Site related	NPP Mil USD	RR < 30 MW Mil USD
Land rights	15	0.5 – 3.0
Site Specific Hazard Studies	10	0.1 – 2.0
Geotechnical and foundation work	25	0.5 – 5.0
Total	50	1.5 – 10.0

The costs are just estimates since the cost of land, cost of hazards assessment and geotechnical work may vary significantly

The cost estimates could be higher if the site protection measures are necessary

The main siting issue: graded Approach in Site and Design Safety

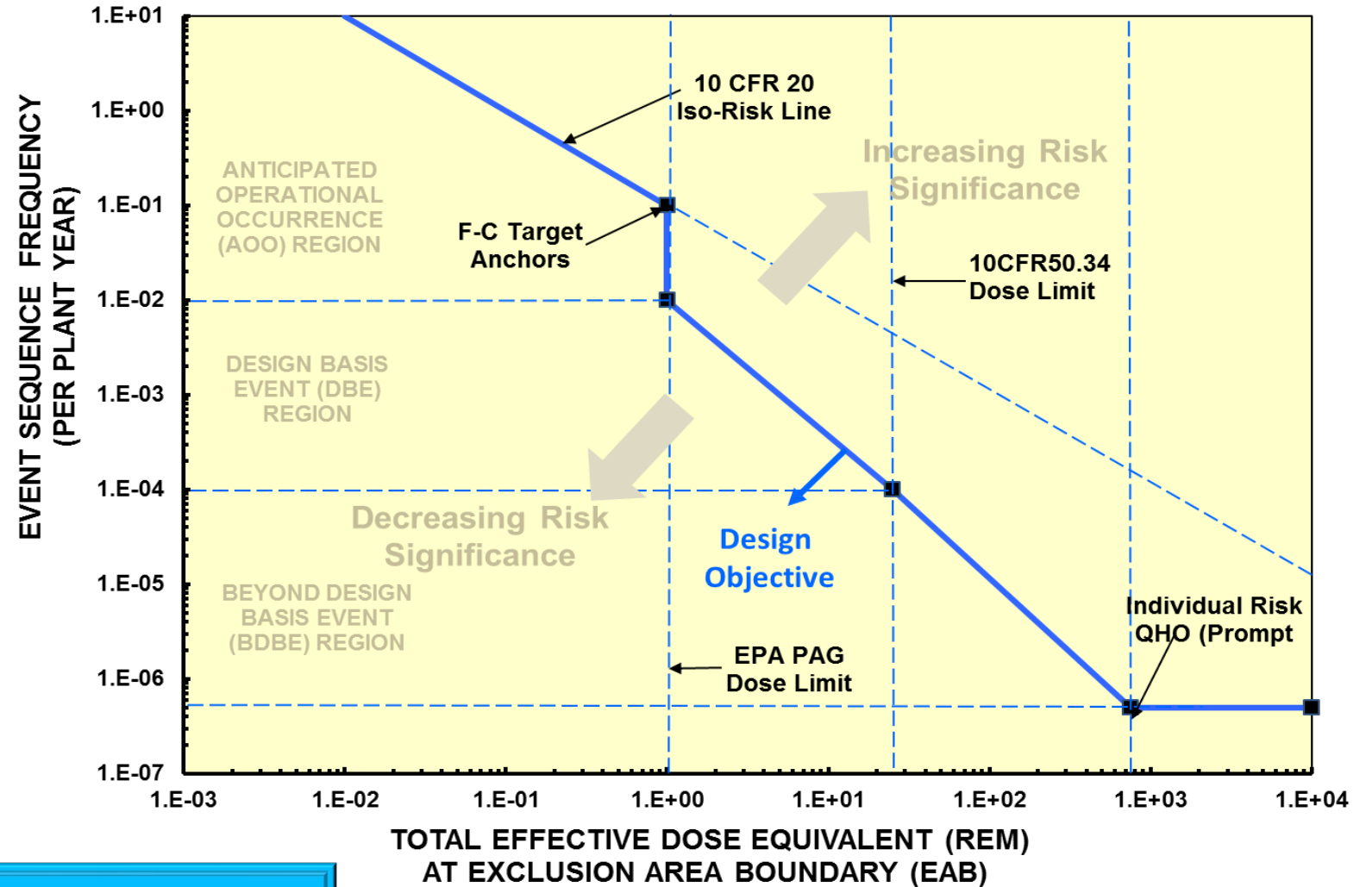
- The governing principle is provided by the IAEA Safety Fundamentals, Principle 5: *‘The resources devoted to safety by the licensee, and the scope and stringency of regulations and their application, have to be commensurate with the magnitude of the radiation risks...’*.
- The application of a graded approach is a **proportional application** of the safety requirements, while keeping the focus on achieving the overall safety objectives, rather than a relaxation of the requirements themselves.
- **Risk-informed and performance-based** strategy integrating site-installation interactions used for new advanced reactor designs (such as SMRs) for achieving an adequate design robustness against external hazards.
- This approach enables the application of a graded approach to site specific hazards characterization, thereby making the engineering effort more efficient and cost effective.

Graded Approach, Site and Design Safety

- Risk-informed and performance-based strategy integrating site-installation interactions used for new advanced reactor designs (such as SMRs) for achieving an adequate design robustness against external hazards.
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Cornerstones of the RIPB Framework

1. Selection and evaluation of licensing basis events (DBEs)
2. Frequency - Consequence (F-C) target and DBE risk-significance criteria
3. SSC classification and performance requirements
4. Defense in depth adequacy evaluations



PSA is an integral part of design

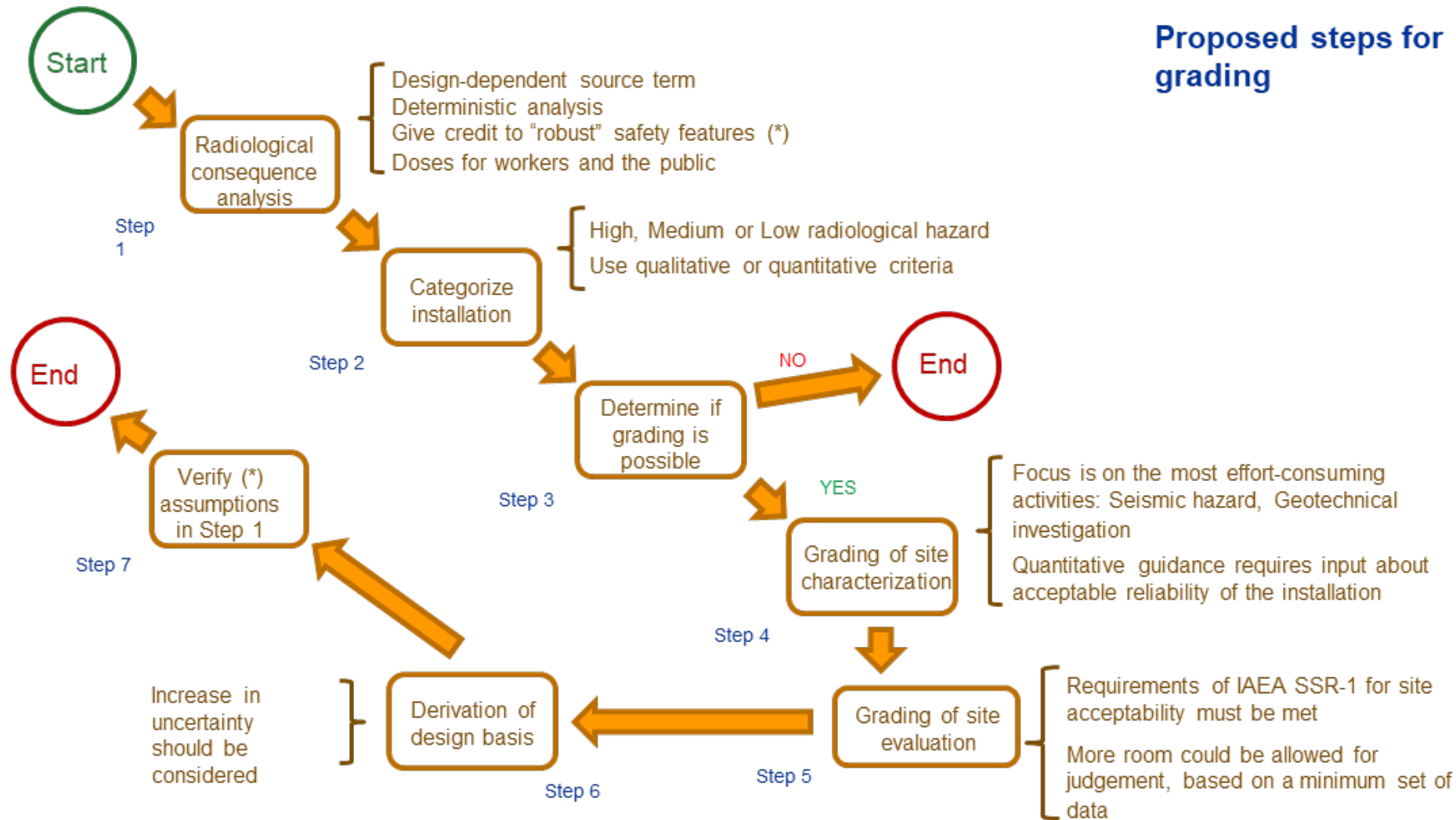
Application of the Graded Approach – The workflow

- Categorization of the facility in accordance with potential radiological hazards.
- The possibility that an external event will give rise to radiological consequences (depend on characteristics of the nuclear installation and on the external event itself).
- The graded approach should generally be applied to the extent and level of detail of the data to be collected and analysed at each step.
- Application of the Graded Approach for Research Reactors is reflected in the IAEA Safety Standards including: SF-1, SSR-1, SSR-3, SSG-9, SSG-12, SSG-18, NS-G-2.13, SSG-22).

Application of Graded Approach

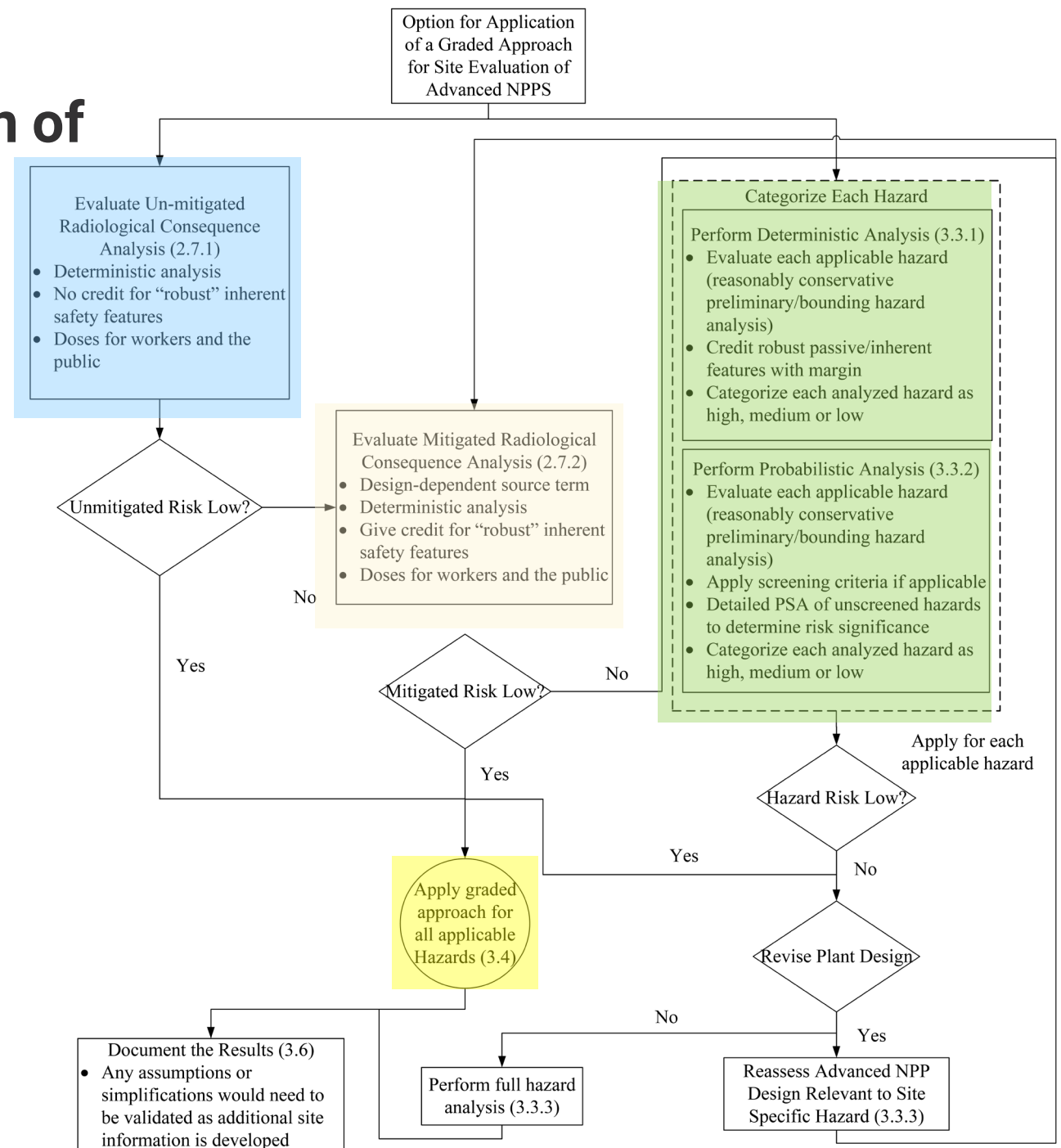
- As a result of this process, the nuclear installations can be categorized:
 - Low hazard category includes those nuclear installations for which national building codes (with some enhancements) for conventional facilities (e.g. essential facilities such as hospitals) can be used.
 - Medium hazard category – typically nuclear grade design codes and hazard level corresponding to 1000 years return period are used.
 - High hazard category includes installations for which nuclear standards and hazards assessment similar to those used for nuclear power plants are used.

A possible Approach for Grading Site Evaluation-based on Consequence Analysis



Possible Approaches for Applying Graded Approach to Site Evaluation of Advanced NPPs (Cont'd)

Overall Process to Apply a Graded Approach for Site Evaluation:



RIPB – Q&A

Which are the advantages in the application of RIPB to siting of nuclear installations?

The application of the RIPB approach since the siting phase enables the development of a graded approach to site investigation and hazard calculation, considering the risk associated with these installations by taking into account their type, size, intrinsic characteristics and safety features. The data collection process and the relevant effort can be graded on the basis of a radiological hazard categorization of the installations.

Which are the advantages in the application of RIPB to design of structures, systems and components?

The major advantage is a consistent approach to the design of safety significant SSCs for beyond design basis ground motions and their safety margin, consistent with their contribution to plant-level safety or risk significance. The compartmentalized approach to design (e.g. considering each SSC separately) results in excessive conservatism in many cases: every individual safety related SSC is designed to the same seismic criteria (SSE) that may not even contribute to overall plant safety and do not provide a consistent way to achieve the desired seismic capability of the overall plant.

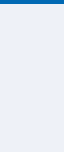
RIPB – Q&A – (Cont'd)

What is the difference with a seismic PRA design driven approach?

SPRA is part of the iterative design approach to SSCs, as SPRA results are checked against the F-C targets and cumulative risk criteria as well as defense in depth, reliability and other risk informed decision making factors, but seismic design category (SDC) and Limit states (LS) are changed consistently in an iterative process targeted to the correct calculation of the safety margin at the facility level, leading to a more uniform, balanced and safety- and risk-consistent plant. Although many SDC and LS combinations can be considered, practical applications should consider only selected combinations validated by the RIPB approach.

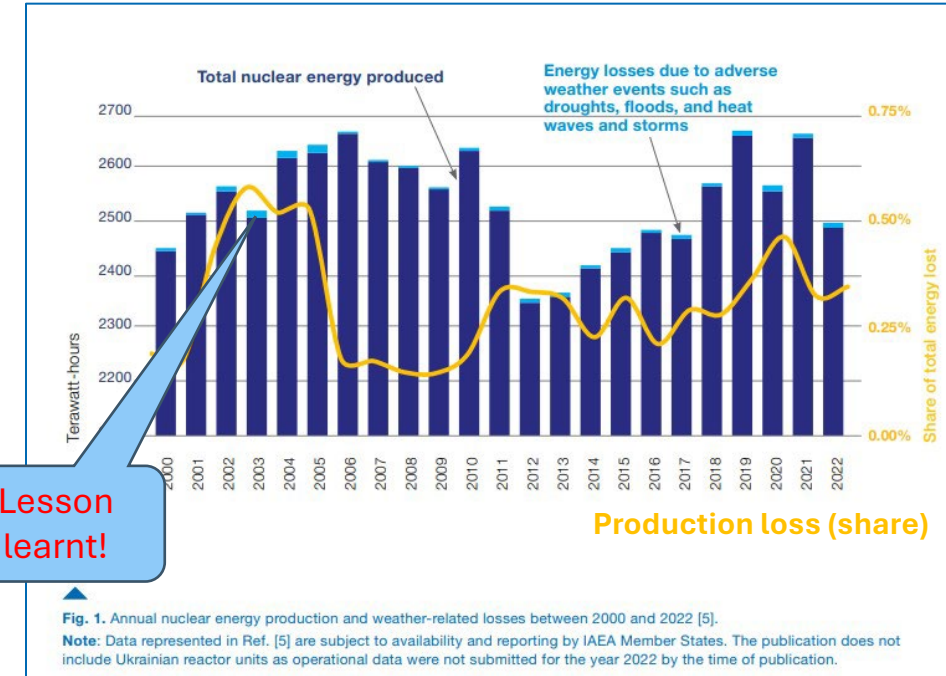
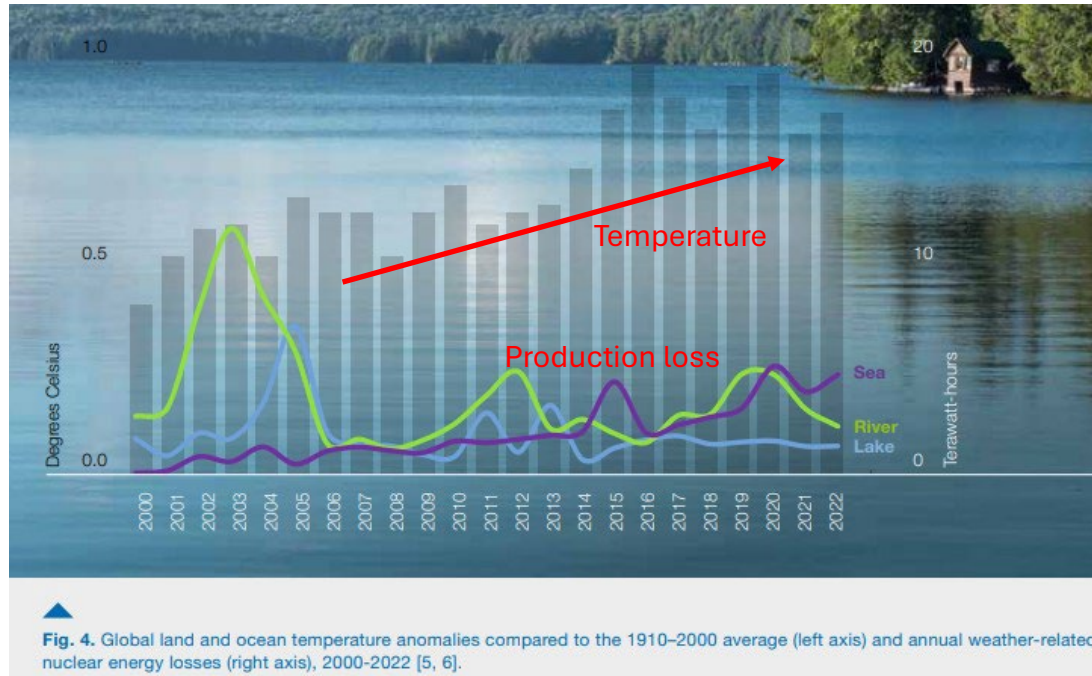
Is the RIPB approach validated in any Country regulations applicable to SMRs?

Yes: ASCE 4-16 provides guidance on how to evaluate seismic demand on individual SSCs in order to demonstrate that sufficient conservatism exists, so that, when used in conjunction with ASCE-43, the design of individual SSCs achieves its specified target performance goal. ASCE-43 develops a graded approach commensurate with tolerable risk. NEI 18-04 proposes a performance based methodology, which is endorsed in NUREG-1860 which is intended to achieve a process that is risk informed and performance based providing flexibility to the licensees or license applicants to meet safety requirements. A new draft RG-1353 has been issued by the USNRC on "Technology inclusive, risk informed and performance based methodology for seismic design of advanced reactors". Some reactor sites in the US have been already licensed according to the RIPB approach according to the .



Special challenge posed by climate change for the deployment of SMRs

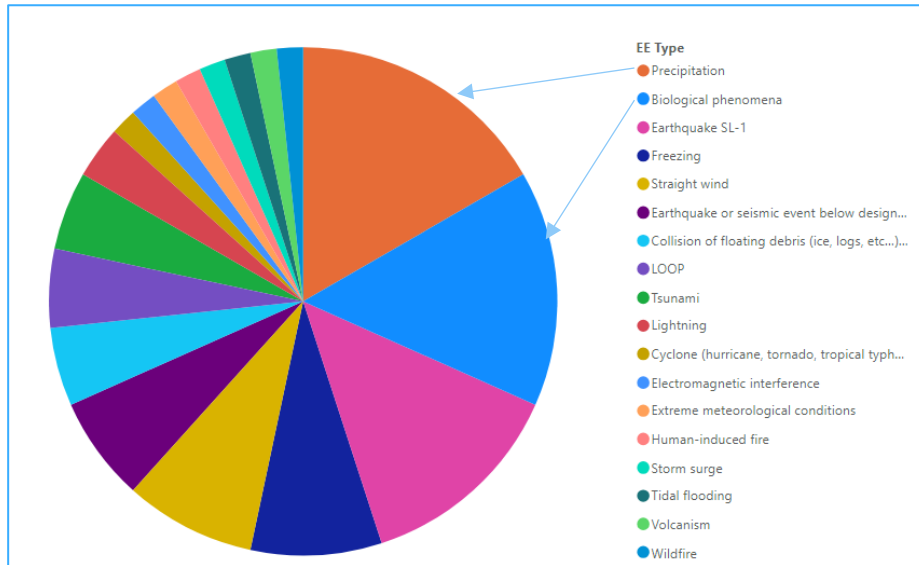
Production losses for weather events in the last decades



(From Nuclear Energy in Climate Resilient Power Systems – IAEA/PESS, 2023)

- The **number of power outages** increased in the last decades but annual **energy losses** due to adverse weather events comprise about 1% of the nuclear fleet's total losses, decreasing in the last decade.
- Historical evidence shows that nuclear power production has proven **its resilience so far** amid increasingly frequent and severe weather events.
- A **quantitative assessment of the safety margin** against unanticipated scenarios is urgent, as only additional quantified preventive measures may provide guarantee for **safe performance in the future**.

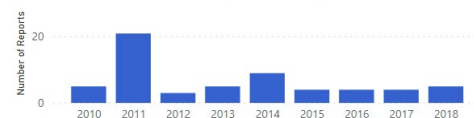
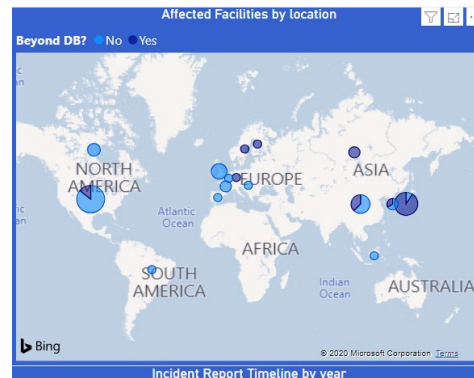
External Events in the last three years affecting NPPs (from the IRS DB at the IAEA)



Impacted systems

1. *Extreme wind (US) -> Station blackout*
2. *Abnormal eelgrass growth (US) -> Intake clogging*
3. *Abnormal growth of shrimps (CH) -> Intake clogging*
4. *Abnormal arrival of clay, debris and vegetation (RU) -> Intake clogging*
5. *Extreme temperature (UK) -> Diesel overheating*
6. *Earthquake (FR) -> Shutdown*
7. *Extreme precipitation (IN) -> Dam release-> Flooding of plant surroundings and access roads*
8. *Extreme wind and storm (KR) -> Foamy salt on breakers and station blackout*
9. *Country blackout (AR) -> LOOP*

IRS is in operation at the IAEA since 1980, for NPPs, Research Reactors, and Fuel Fabrication Facilities (3000 events)

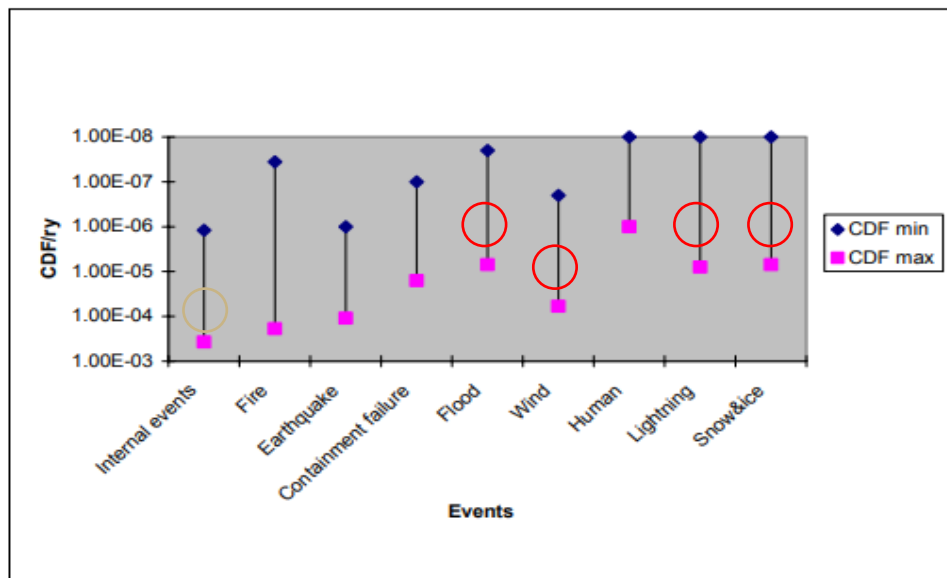


GENERAL CONCLUSIONS

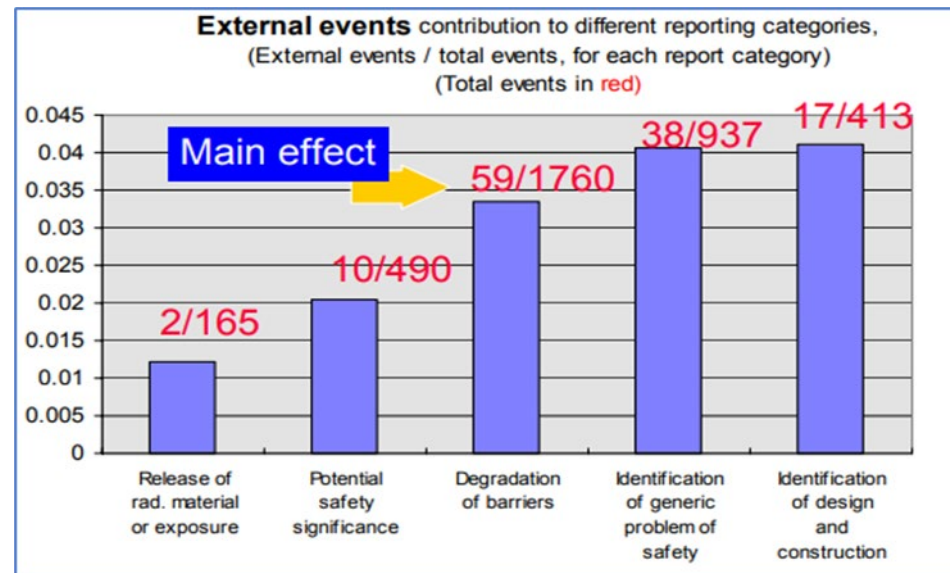
- *Most reported incidents are related to scenarios affected by climate change, also increasing in recent years*
 - *Meteorology / precipitation / flooding (30/60)*
 - *Seismic and Tsunami (15/60)*
 - *Biological phenomena (9/60)*
- *Most reported incidents are related to combinations of events or consequential hazards*
- *Most affected SSC for all types of events*
 - *Electrical components (20%)*
 - *Service water (12%)*
 - *Primary system (9%)*
 - *Structural (6%)*

Challenges to plant safety - Deterministic and probabilistic assessment

Very significant contribution is expected by climate-change related scenarios on CDF and safety significant scenarios



US/NRC, Perspectives gained from the individual plant examination of external events (IPEEE) programme, NUREG-1742, NRC, Washington, April 2001



IAEA, Tecdoc 1341, Extreme external events in the design and assessment of nuclear power plants, March 2003 – A new assessment of external events in the period 2000-2020 is in progress at EESS

Effects of climate change affected scenarios are quite similar and relevant among all plant types. The impact on **SMRs and advanced reactors may become dominant on CDF and LERF**

Proposed strategy for enhancement of protection

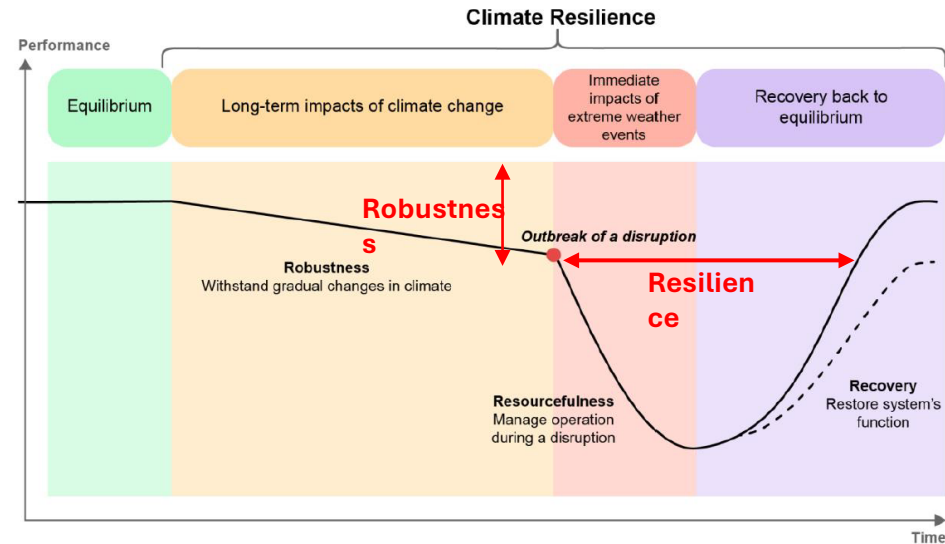
The following safety related measures in relation to climate change effects are under assessment at MSs:

- Improved approach to **scenario screening**
- **Improved hazard** evaluation approach, with uncertainty control, simulation of climate change and load combination – Periodic hazard review
- **Risk analysis** for assessment of the beyond design basis margin and cliff-edge effects
- Dedicated site monitoring + **regional monitoring**
- **Movable on-site safety** emergency systems for operating plants
- Movable protection devices on-site for operating plants (e.g. barriers)
- Improved **component qualification** methods (by similarity?) for periodic re-assessment and post event recovery
- Review of **safety objectives** for population, including power availability
- Consideration of a “**System Resilience**” approach in addition to “**Robustness evaluation**”
- Post event **fast recovery plans** for short business interruption

Intl. Conference on Resilience of Nuclear Installations against External Events from a safety perspective – Focus on Climate Change

20-24 October 2025

Conceptual framework for climate resilience of the electricity system

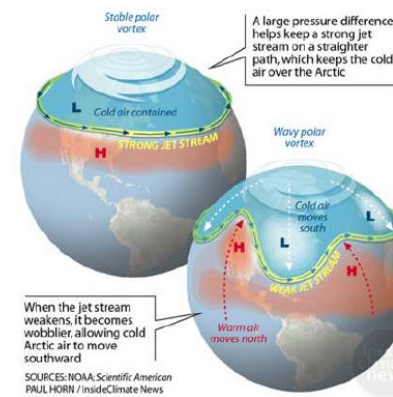


Craig Hart, IEA, 2021

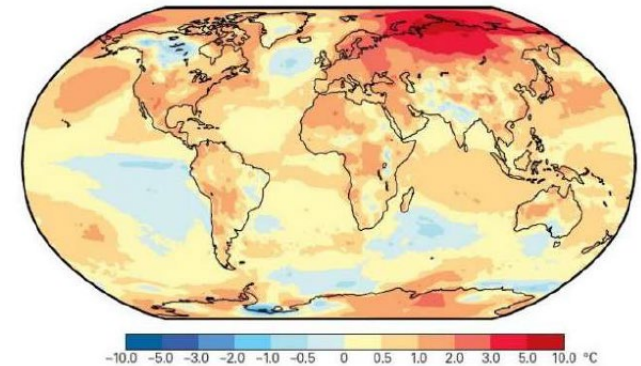
1. Analysis of the **Lesson learnt: proactive approach**, including the near misses, review of modelling for anticipating possible scenarios, methods for risk assessment, operation measures, preparedness to manage accident consequences and business interruption in the short, medium and long term.
1. New Hazard analysis: new local-global **time-dependent hazard models**, and accurate modelling for anticipating possible scenarios
2. Develop **new risk indicators and risk assessment approaches**: resilience, robustness, radiological risk, business interruption, etc. and consequently extend the risk analysis (performance based) to the whole production and **distribution infrastructure**
3. Encourage the development of **contingency plans** at nuclear infrastructures and their regions, supported by regional monitoring, **vital areas identification** and risk assessment engineering, pre and post event operation procedures

Hazard parameters relevant to NPP safety affected by climate change – Major events in the worldwide fleet

- The following physical climate variables (dependent) have been recognized as safety relevant. They have been changing in the last years (sources: IAEA, WMO)
- **Event magnitude**, beyond design basis: extreme temperature (+3C), heavy precipitation, sea level rise (+3mm/y), river flow rate, wind speed, etc.
- **Hazard type**, previously screened out: sandstorms, droughts, wildfires (+20%), salt sprays, rotational winds at high latitudes
- **Hazard source**, previously excluded in consideration of the climatic region: permafrost melting
- **Combination of hazard**, previously screened out: heavy rain+earthquake+landslides, flooding+ice blockage+debris damage
- **Increase in frequency**, previously underestimated as mean values and uncertainty: storminess, lightning, etc.
- **Increase of speed of development**, previously considered “non-physical”: large hurricane drift speed and intensity



Primary physical climate variables



Examples of accidents triggered by abnormal values of physical climate variables

- South Korea's move to shut two nuclear reactors due to an influx of marine organisms (22/03/2021)
- Salt sprays on insulator trigger fire at Maanshan (2001)
- UHS safety related tanks were locked by freezing at Chinon 1987
- Ice floes transported by the river Loire caused the unit 1 water intake sudden blockage at Saint Laurent des Eaux (1987)
- Lightning strikes opened and closed several times the circuit breakers at David Besse (1998)
- Heavy smoke invaded the site and fire approached the site fence at Cadarache (1989)
- Hurricane Ida moved from cat 1 to 4 in one day, wind speed from 130 to 240 km/h (2021)

2004 Chuetsu Earthquake: landslide due to combination of heavy precipitation and earthquake





The IAEA support to climate change specific issues

The External Event Safety Section

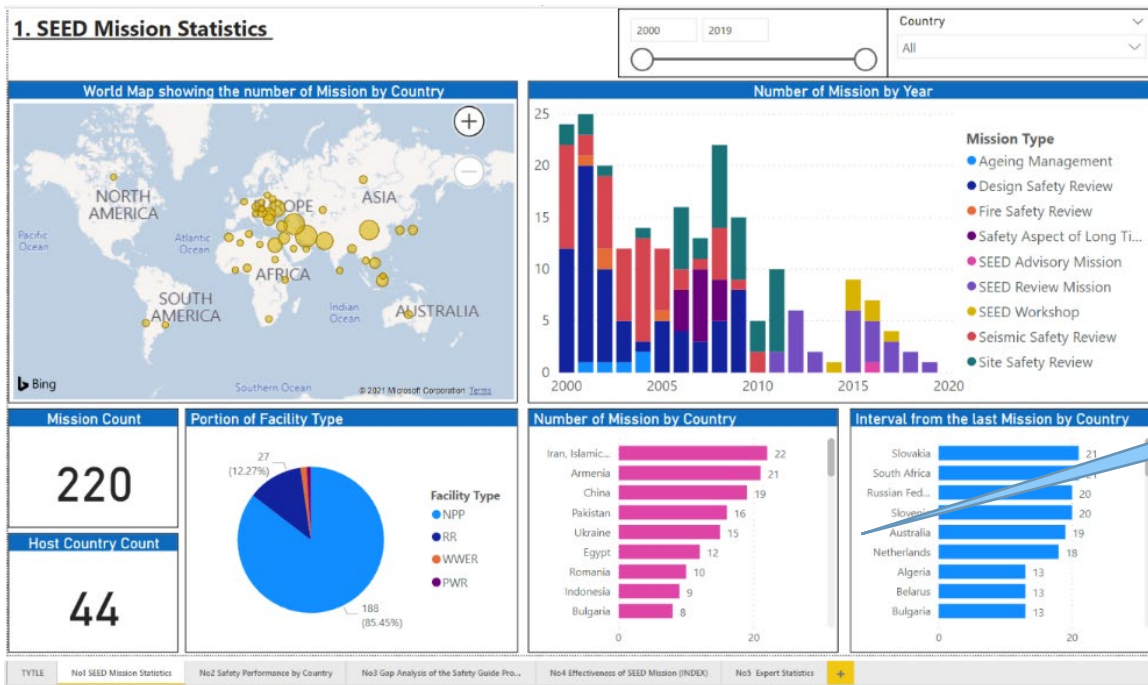
From MS feedback assessment to projects and products

- **SEED Service** – Safety review on site, design and safety assessment
- **External Event Notification System (EENS)**
- Annual **Extra Budgetary Program** technical meetings

Provide feedback to the EESS on the need for special products/guidelines

1. Safety Guides – review of SSG-18
2. Technical documents (Safety Reports and Tecdocs)
3. Research Project (CRP) on “Climate Change Challenges to the Safety of Nuclear Installations”
4. International Conference “*Resilience of Nuclear Installations against External Events from a Safety Perspective - Focus on Climate Change*”, October 20-24, 2025, Vienna – Austria

1. SEED Mission Statistics



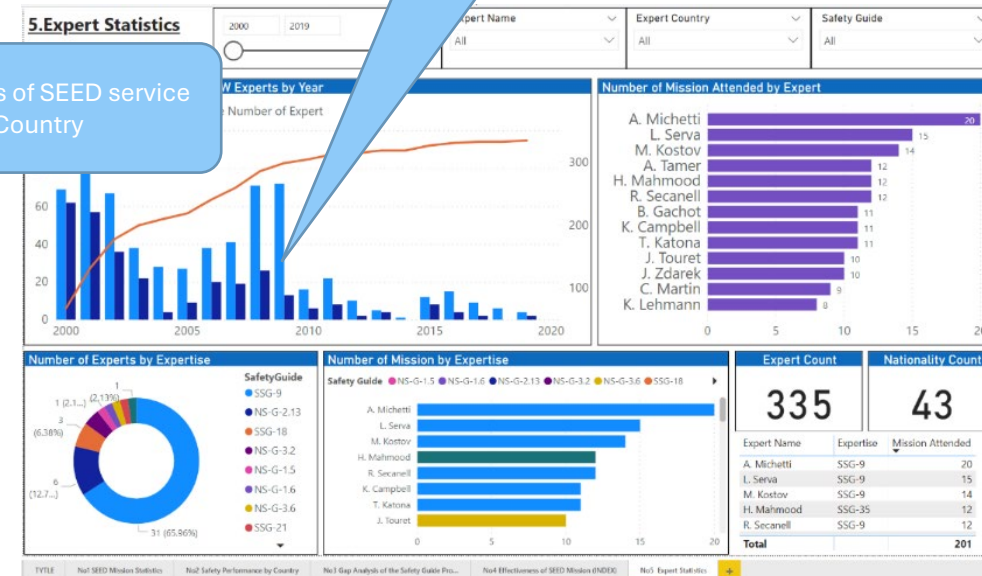
The starting point – Info sources

SEED statistics, by Country, by type, by frequency

Statistics on experts and their review areas

Effectiveness of SEED service by Country

5. Expert Statistics



3. Gap analysis of the Safety Guide Program

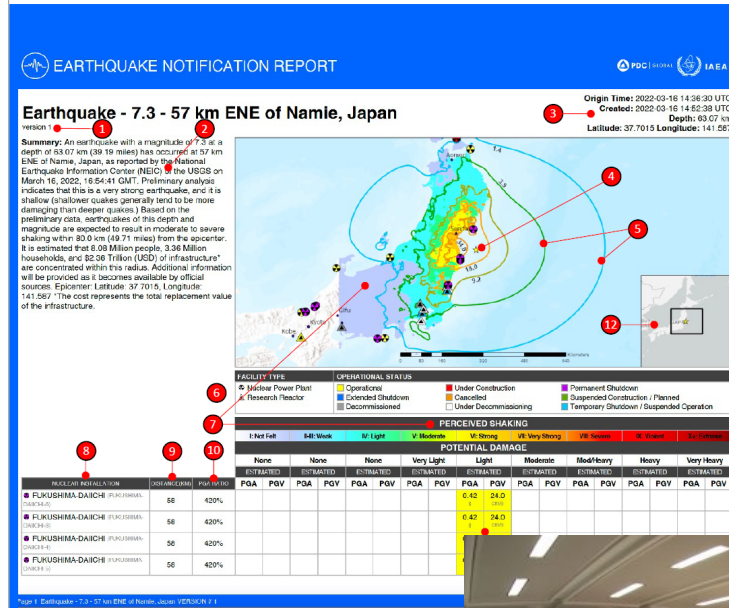


Statistics on coverage of safety issues by the Safety Guide Program

Supported by an AI engine reading PDFs

External Event Notification System

EESS Alert and assessment Tool (IEC + OECD/NEA)



In 2024

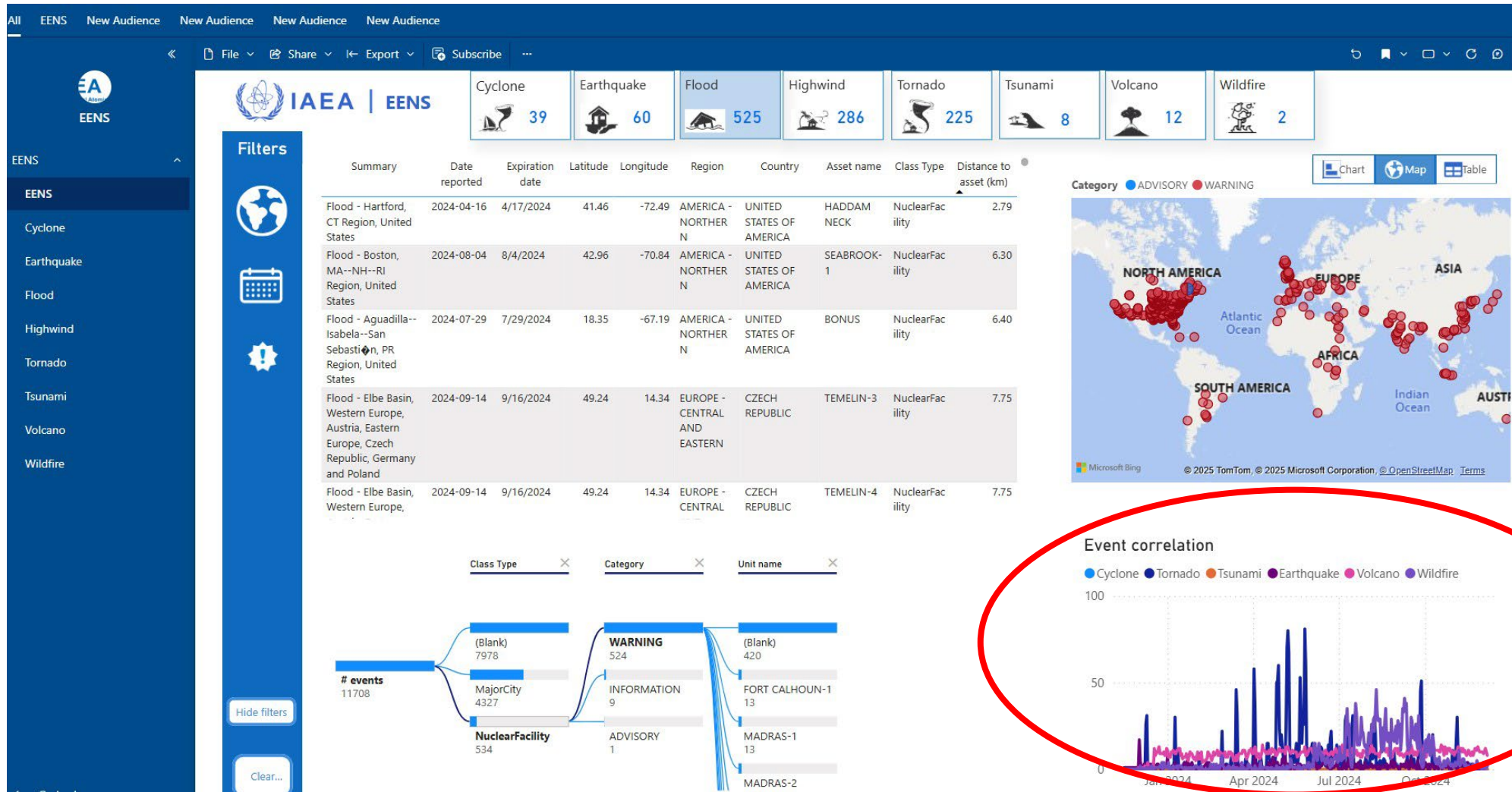
- Earthquake records (947)
- Flooding records (13116)
- Wildfire records (3021)
- Volcano records (7105)
- Tsunami records (7)
- Tornado records (3175)
- Highwind records (277)
- Cyclones records (51 summary reports + 664 cyclone reports)



- Shake/influence maps
- Damage forecast and assessment to NPPs and population – **Statistics on Near Misses**
- **Alert to IEC**
- All EEs (Winds, Flood, Tsunami, Fire, etc.)
- Real time to IEC
- Cooperation with OECD/NEA WGs
- **Live since August 2023**



Data analysis – EENS Viewer and Analyser



Workshops, training events and webinars to support regulators and operators to build their capabilities in site and design safety

Tecdoc "A Handbook for Education and Training Programme on Nuclear Site Safety for Regulatory Bodies in Embarking Countries"



The External Events Safety Section provides support to Member States in [building and sustaining capacity in nuclear safety](#).

Education and training

- As part of the [Site and External Events Design Review Service \(SEED\)](#), the [SEED Guidelines](#) on how to prepare and conduct SEED review missions can be used as training material.
- Collection of training material on site selection and site evaluation for nuclear installations, radiological environmental impact assessment of nuclear installations, design of nuclear installation against external events, safety assessment of existing nuclear installation against external events and for safety standards on site and design safety in relation to external events.

Knowledge management

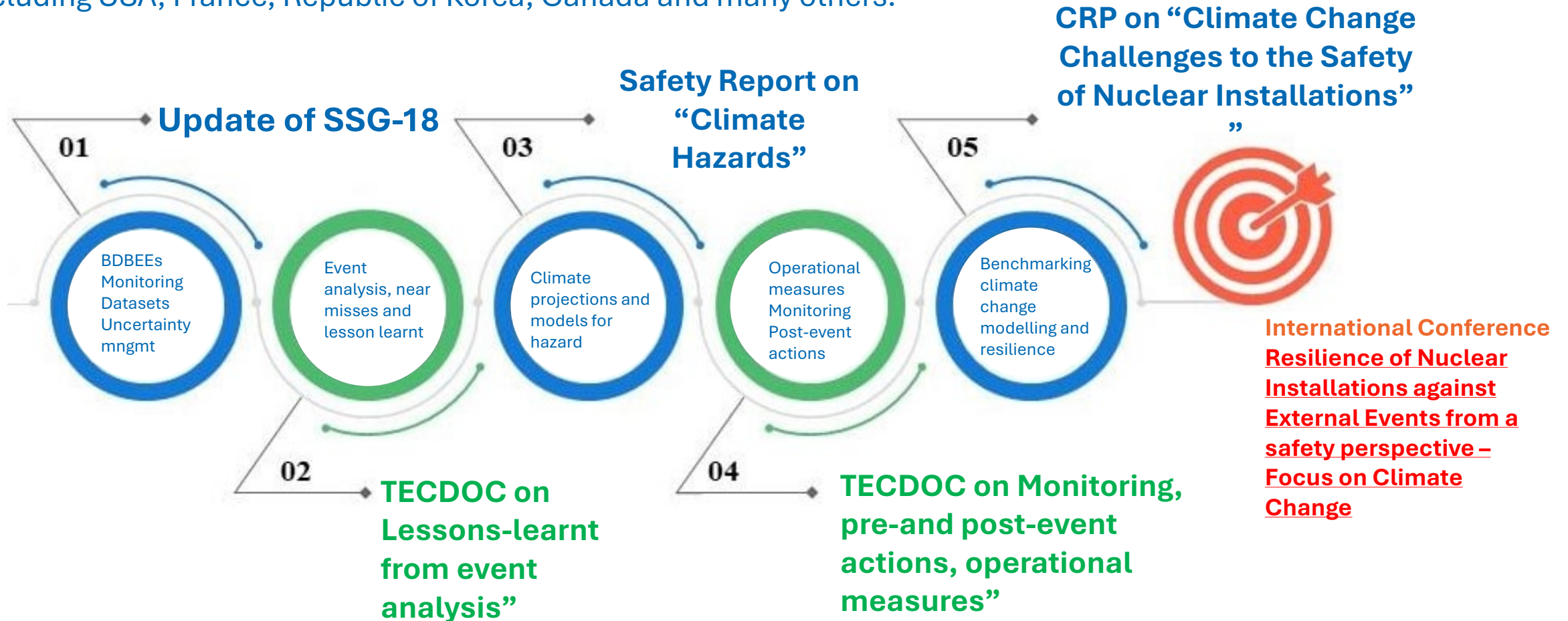
- The [EESS Portal](#) (login required) contains research outcomes and state of art practice (technical reports, research advancement, presentations) for: external hazards assessments, design against external hazards, safety assessment against external hazards, seismic experience database. It is of added value in particular as knowledge repository for the nuclear safety community on the state of art methods for the assessment of site and design safety in relation to external events.
- The seismic experience database (login required) contains reports on the states of nuclear power plant components after they have been exposed to earthquakes of various intensity
- The external events notification system (login required) contains earthquake notification reports related to the occurrence of external events around the world in the region of nuclear installation sites
- The SEED review mission report database (login required) contains SEED review mission reports conducted in Members States

Related resources

- 🔗 [Division of Nuclear Installation Safety: Capacity Building Activities \(full list\)](#)
- 🔗 [List of IAEA training resources \(CLP4NET\)](#)
- 🔗 [List of global training resources on nuclear safety \(GETR\)](#)
- 🔗 [List of knowledge networks under GNSSN](#)
- 🔗 [Search the IAEA Peer Review and Advisory Services Calendar \(including past events\)](#)

IAEA Documents and events on Climate Change Impact on Nuclear Installations

This is a multi-dimensional project kicked off in 2022 with the financial and in-kind support of several Member States including USA, France, Republic of Korea, Canada and many others.



Coordinated Research Project (CRP): Climate Change Challenges to the Safety of Nuclear Installations

EESS has developed a Coordinated Research Project (CRP) focusing on flooding hazards.



The objectives of the CRP are:

- ✓ Identifying the methodical differences in the current practices for including climate projections in hazard estimates,
- ✓ Performing a benchmarking flood hazard analysis on the case studies to understand the differences,
- ✓ Developing high level recommendations on the impact on climate change on the meteorological and hydrological hazards.



6 research agreements are signed with:

- Argonne National Lab.
- EDF France
- EPRI
- KAERI
- Middle East Technical University
- Toronto Metropolitan University



12 research contract are signed with:

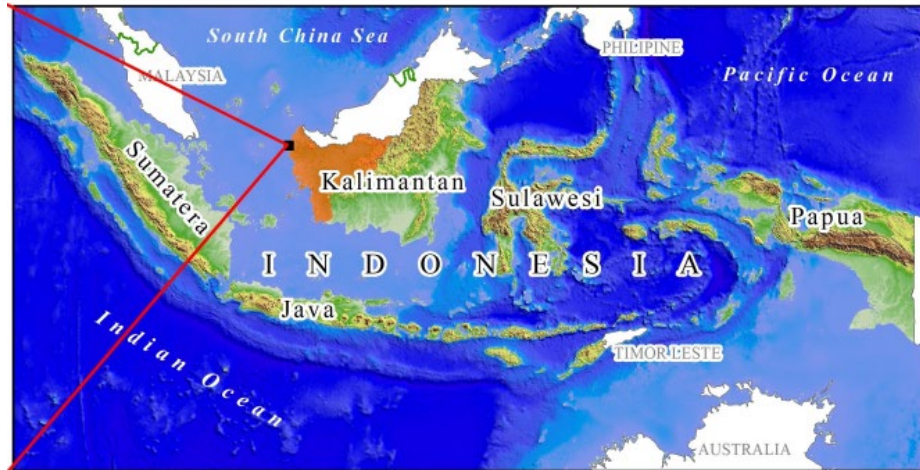
- | | |
|--------------|--------------|
| ▪ Bangladesh | ▪ Jordan |
| ▪ China | ▪ Kazakhstan |
| ▪ Egypt | ▪ Malaysia |
| ▪ India | ▪ Morocco |
| ▪ Indonesia | ▪ Nigeria |
| ▪ Ghana | ▪ Pakistan |

The project started with the first Research Coordination Meeting in June 24-28, 2024.

Coordinated Research Project (CRP): Climate Change Challenges to the Safety of Nuclear Installations

Two benchmark cases have been developed:

Coastal site: Kalimantan, Indonesia



With significant contributions of PAEC and BRIN

River site: Chasma, Pakistan



The participants are:

- ✓ Provided the same dataset to perform either coastal or riverine flood analysis,
- ✓ Researchers from embarking countries are coupled with mentors from more experienced groups,

Analysis will be performed for same boundary conditions and compared in the next RCM meeting.

Second Research
Coordination Meeting
June 23-27, 2025.

High resolution climate model predictions are downscaled for both sites by
Argonne National Lab.

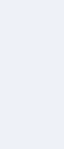
IAEA International Conference – NIRC2025

- Focuses on Hazards, Resilience, Safety assessment, Operation issues
- Themes/Tracks
 - Evolving Hazards
 - Response of NI to Hazards (impact)
 - New Safety Features of Advanced Reactors
 - Post-Event Response
 - Risk Informed Approaches to Design and Regulation
 - Regulatory Matters



Key Deadlines and Dates:

- **31 May 2025:** Submission of abstracts through IAEA-INDICO
- **31 May 2025:** Submission of Form A, and if applicable Form B and Form C through the InTouch+ platform
- **30 June 2025:** Notification of acceptance of synopses for oral or poster presentation
- **13 October 2025:** Submission of Form A only (no paper submissions, no grant request) through the InTouch+ platform.



CONCLUDING REMARKS



CONCLUDING REMARKS

SMRs offer unique opportunities for modular, safe, and flexible nuclear energy solutions.

A graded approach to siting SMRs is recommended by the IAEA Requirements: it has to comply with the final safety requirements.

A graded approach is an open concept:

- There may be several ways to grade siting activities
- Graded safety assessments balance reduced risks with efficient resource use.

Climate Change should be addressed since the early stages of SMR siting

Comprehensive hazard analysis and monitoring ensure robust safety across different designs, including the existing fleet.



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Atoms for Peace and Development



Thank you!
Questions?

P.Contri@iaea.org