Canadian Nuclear Safety Commission / Commission canadienne de sûreté nucléaire

Canada

The Canadian Nuclear Safety Commission – Domestic and International Licensing

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Today's Presentation

PART I:

Canadian Nuclear Safety Commission - Licensing Process

PART II:

International Experience in the Regulation of SMRs

PART III:

SMR Regulators Forum – Best Practices

Part I:

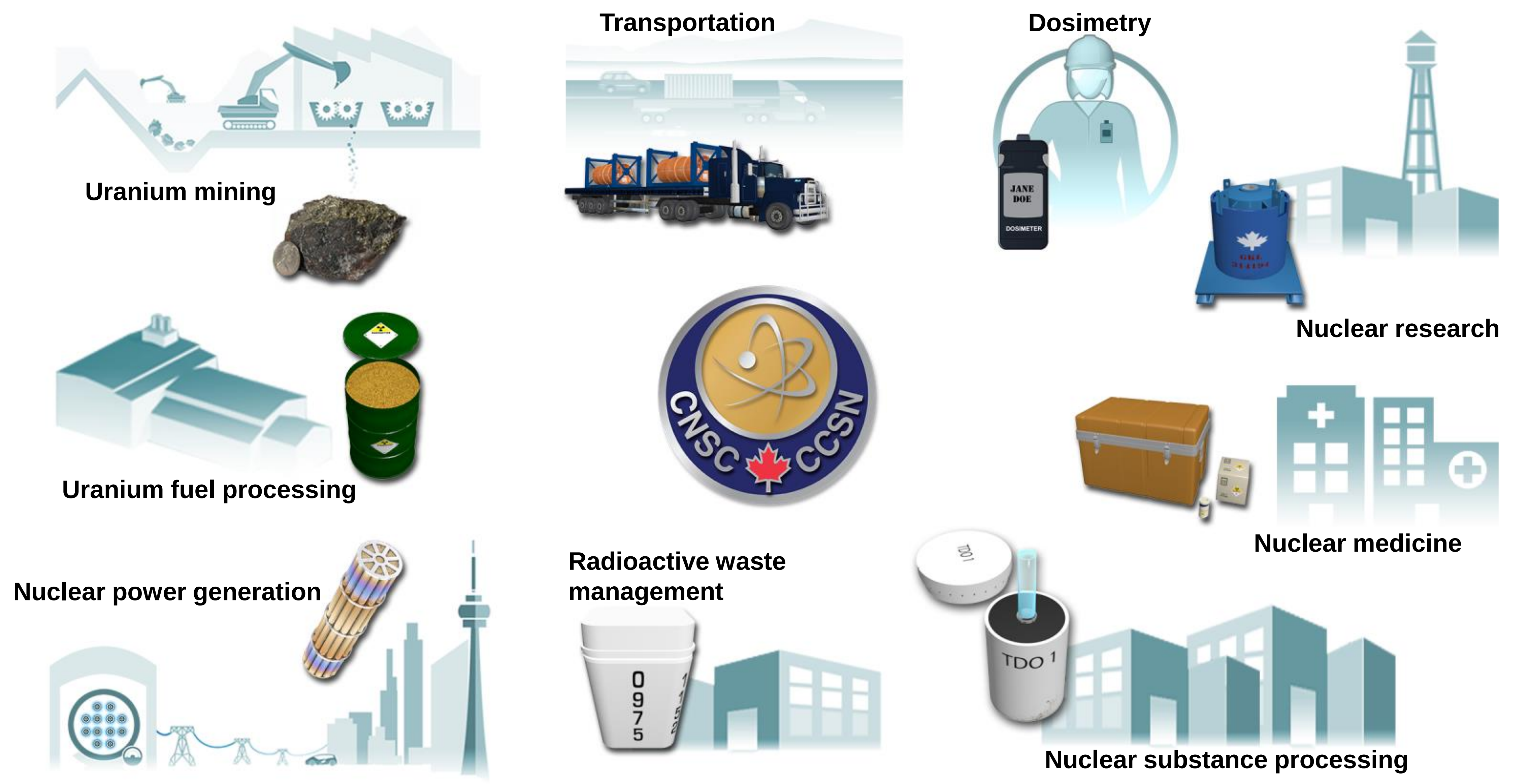
The Canadian Nuclear Safety Commission

Welcome to the Canadian Nuclear Safety Commission

CNSC Mandate

- Regulate the use of nuclear energy and materials to protect health, safety, security and the environment
- Implement Canada's international commitments on the peaceful use of nuclear energy
- Disseminate objective scientific, technical and regulatory information to the public

The CNSC Regulates All Nuclear-Related Activities



The Commission

- Quasi-judicial administrative tribunal
- Agent of the Crown (duty to consult)
- Reports to Parliament through Minister of Natural Resources
- Commission members are independent
- Decisions are reviewable by Federal Court

TRANSPARENT, SCIENCE-BASED DECISION MAKING

CNSC Staff

Highly skilled, scientific, technical and other professional staff

Implement Commission decisions

Verify and enforce compliance with regulatory requirements

Develop regulatory requirements and guidance

Engage the public and Indigenous groups through outreach

Public Engagement

CNSC Outreach Program

- Makes CNSC directly accessible to the public
- Allows for dissemination of impartial information
- Examples include engagement sessions in local communities, CNSC Meet the Nuclear Regulator and webinars

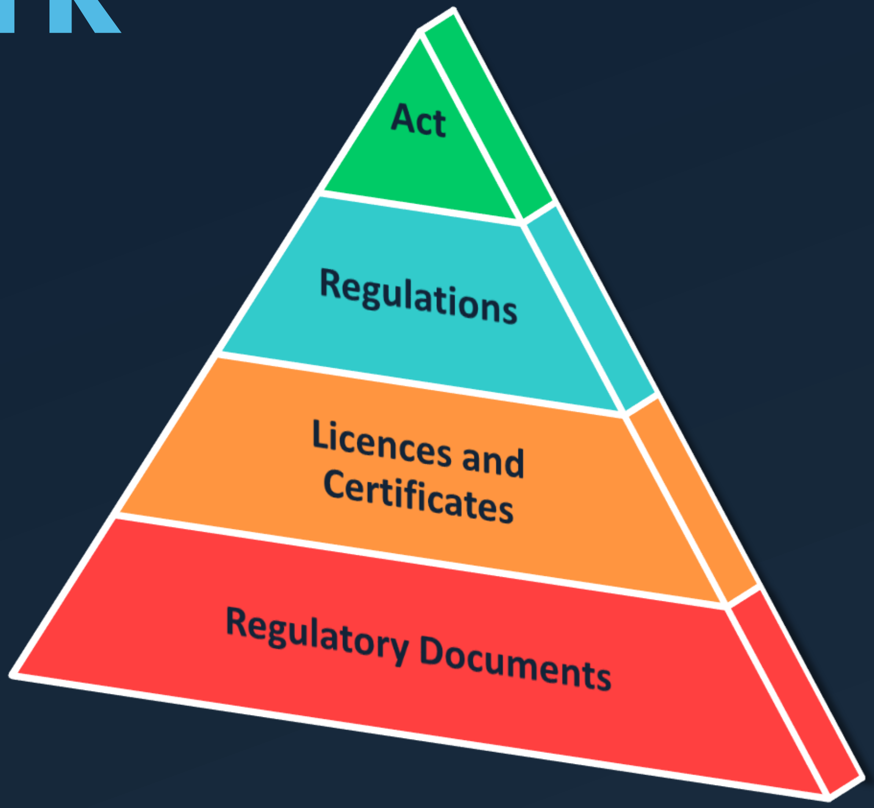
Public Information and Disclosure Program

- A CNSC requirement for licensees
- Promotes transparency and understanding of the licensed activities and operations

CNSC:
Basis for a Licence

Regulatory Framework

- *Nuclear Safety and Control Act*
  - Enabling legislation
- Regulations
  - High-level requirements
- Licences, Licence Conditions, Certificates
  - Facility and/or activity-specific requirements
- Regulatory Documents
  - Additional requirements, industry standards and guidance



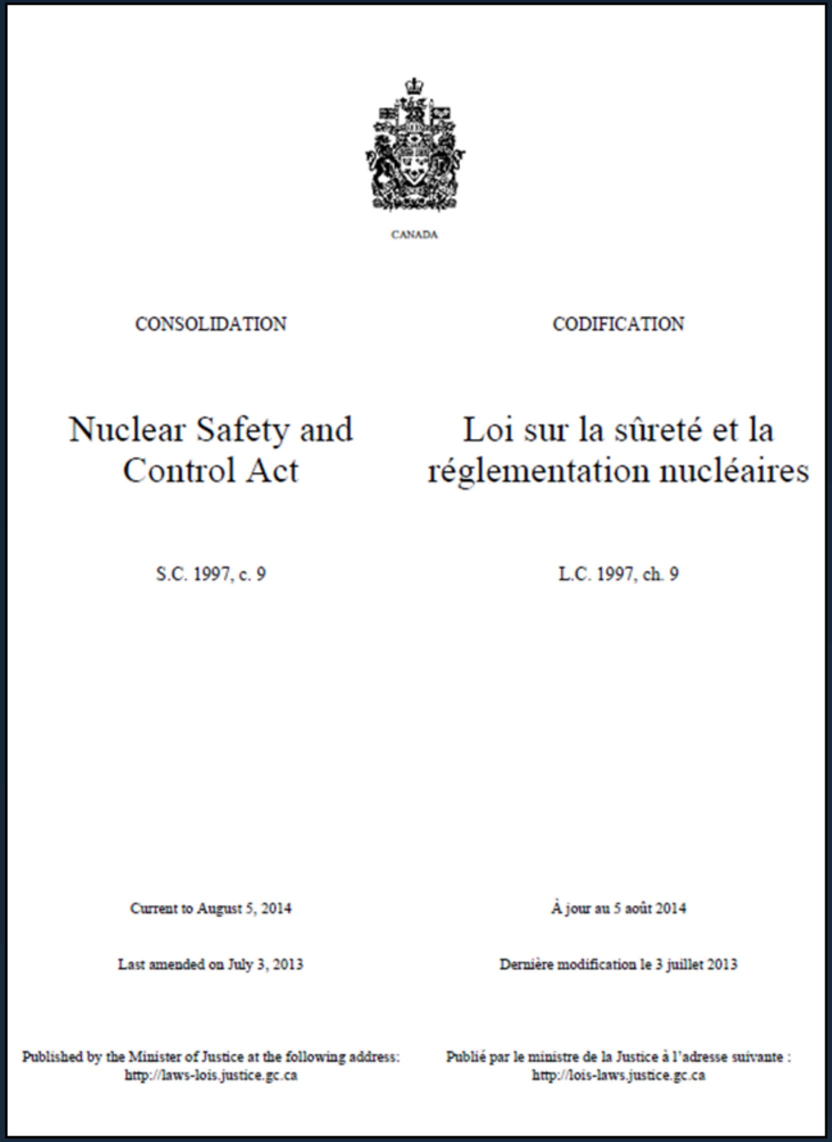
CNSC’s Regulatory Framework

CNSC Licences

Are legally binding

Contain the licensee name, activities authorized, and licence period

Include general licence conditions, and specific ones as needed


CANADA

CONSOLIDATION	CODIFICATION
Nuclear Safety and Control Act	Loi sur la sûreté et la réglementation nucléaires
S.C. 1997, c. 9	L.C. 1997, ch. 9
Current to August 5, 2014	À jour au 5 août 2014
Last amended on July 3, 2013	Dernière modification le 3 juillet 2013
Published by the Minister of Justice at the following address: http://laws-lois.justice.gc.ca	Publié par le ministre de la Justice à l'adresse suivante : http://lois-laws.justice.gc.ca

Licensing Basis

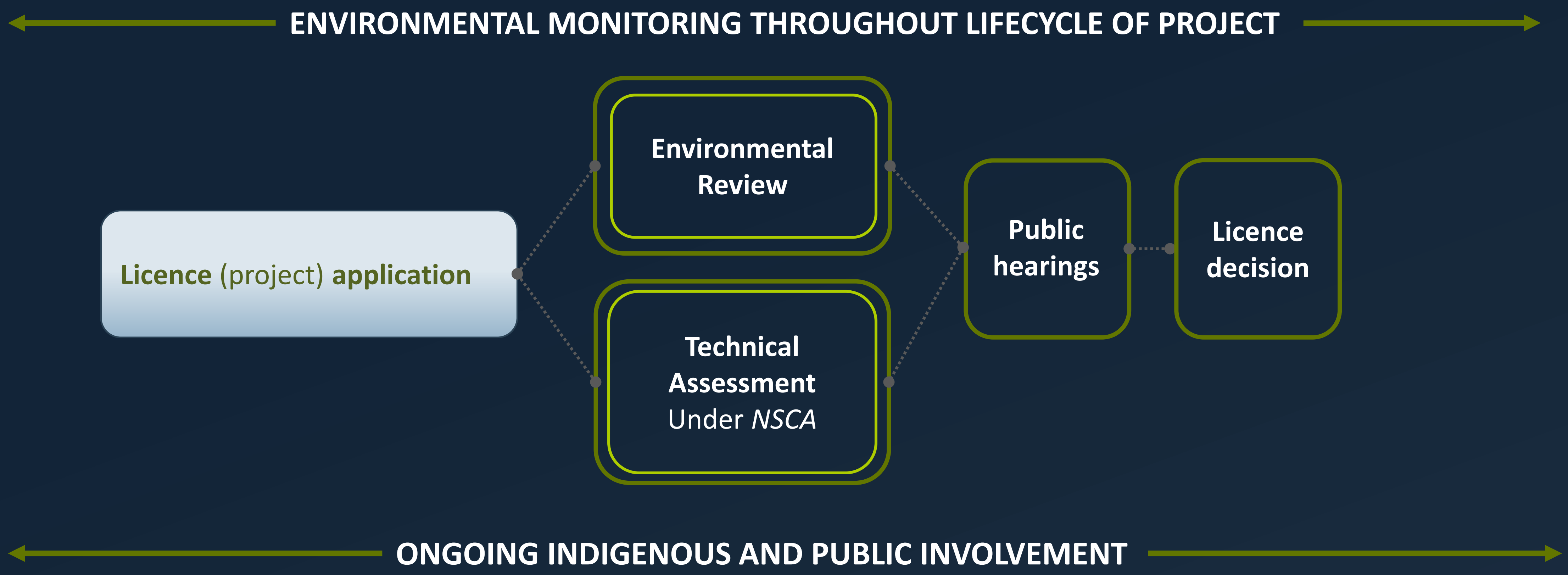
The licensing basis sets the boundary conditions for a regulated activity.

It includes:

- The regulatory requirements set out in the applicable laws and regulations
- The conditions and safety and control measures described in the licence, and the documents directly referenced in that licence
- The safety and control measures described in the licence application and the documents needed to support that licence application

CNSC:
Licensing Process

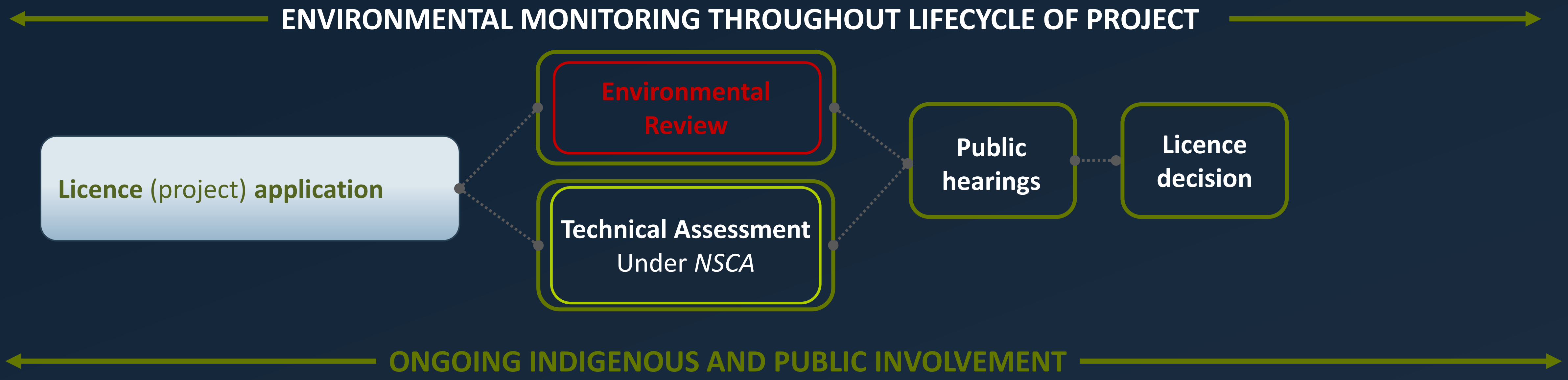
CNSC Licensing Process for Major Facilities



Environmental Review

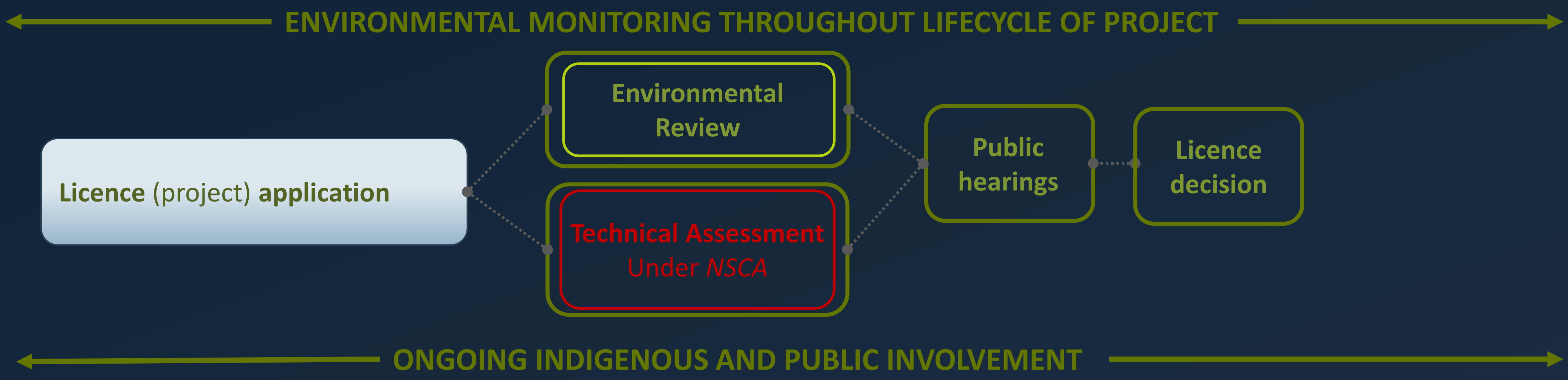
Always conducted for licensing of major facilities. Includes these types:

- Environmental Assessment under Canadian Environmental Assessment Act, 2012
- Impact assessment under the *Impact Assessment Act* (IAA)
- Federal Lands Review under IAA
- Review under Provincial or Territorial requirements or Land Claim agreements
- Environmental Protection Review under the Nuclear Safety and Control Act



Technical Assessment

- CNSC **experts conduct a thorough technical assessment** of information submitted by applicants/licensees in support of their applications
- **Technical assessment focuses** on determining whether the proposed design, safety analysis, operation, and other provisions comply with regulatory requirements



Technical Assessment Process

- Rigorous regulatory review through the conduct of technical assessments
- Licence application and supporting documentation are assessed against regulations, regulatory documents, international guidance, Canadian Standards Association, etc.
- CNSC staff also engage 3rd party reviewers as necessary (e.g., academics, international experts)
- CNSC staff can perform internal verification as necessary such as safety analysis modelling and peer reviews
- Topics include: long-term safety assessment, operational safety analysis, detailed decommissioning plan, waste inventory, etc.

- Process continues until staff are satisfied all requirements are met

Public Hearing and Commission Decision

- Licensing hearings are open to the public and webcast
- In its decisions, the Commission takes into consideration input from CNSC staff, public, Indigenous groups, the applicant and other stakeholders
- Commission decisions and their reasons are published

Indigenous Engagement and Consultation

- As an agent of the Crown, CNSC consults with potentially impacted Indigenous peoples to understand and address potential impacts to Indigenous or treaty rights from licensed activities
- CNSC participates a whole-of-government approach to improve the efficiency/effectiveness of engagement and consultation
- CNSC takes relationship-oriented approach

Building long-term positive relationships
with Indigenous peoples in Canada

Environmental monitoring

- CNSC evaluates licensees' and applicants' environmental monitoring and protection programs
- CNSC also independently monitors the environment in public areas around nuclear facilities
  - Complements CNSC assessments of licensees' environmental protection programs
  - Sampling air, water, soil, sediment, vegetation and food
    - Sampling plans often developed in collaboration with Indigenous communities
  - Interactive map on CNSC website
    - https://nuclearsafety.gc.ca/eng/resources/maps-of-nuclear-facilities/iemp/index.cfm

Designated Officer and Certificates Risk informed approach

Designated Officers carry out low-risk licensing, certification, and compliance decisions

- Compliance decisions (orders, administrative monetary penalties)
- Certification of people and prescribed equipment
- Certification of packaging for transport of nuclear substances

CNSC and use of a Graded Approach

- Proponents must demonstrate how their outcomes meet regulatory requirements, fundamental safety functions, demonstrates defence-in-depth and will provide the information to support appropriate safety margins
- Safety margins include:
    - design features such as thicker pipe walls or additional instrumentation; and
    - operational approaches such as increased inspection frequency, staffing levels and qualifications of staff or a more restricted operating envelope
- Supporting evidence will play a major role in making a regulatory decision
    - Evidence needs to be relevant, credible and of appropriate quality

The Graded Approach can result in *more stringent* requirements

Use of Alternative Approaches

CNSC will consider alternative approaches where:

- The alternative approach results in an <u>equivalent or superior</u> level of safety
- The application of the requirements conflicts with other rules or requirements
- The application of the requirements would not serve the underlying purpose, or is not necessary to achieve the underlying purpose

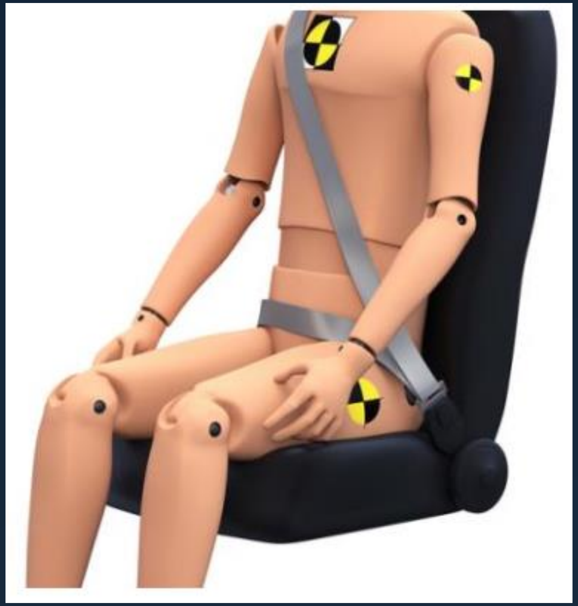
A proposal for an alternative approach must be supported by relevant research, operating experience and other applicable information

Example of a Graded Approach

Fundamental Safety Objective:

Restrain occupants to manage collision energy away from humans and mitigate injuries

Versus



Interpreting Requirements

Section 8.5 of REGDOC 2.5.2 on Emergency Core Cooling System:

> *All water-cooled nuclear power reactors shall be equipped with an emergency core cooling system (ECCS). The function of this safety system is to transfer heat from the reactor core following a loss of reactor coolant that exceeds makeup capability. All equipment required for correct operation of the ECCS shall be considered part of the system or its safety support system(s).*

Is an emergency core cooling system always required?

- The function needs to be considered as part of defence in depth
- Section 11 allows for alternative approaches; taking the ECCS's safety objectives into account
- Which SSCs will reliably execute this function under all plant states?

Fundamental safety objectives must be addressed

Part III:

SMR Regulators Forum – Best Practices

SMR Regulators Forum – Licensing Best Practices

- Licensing First-Of-A-Kind
- Key Regulatory Interventions
- Licensing Multi-unit facilities
- Human Factors
- Configuration Management
- Shared Control Rooms

What is a FOAK

FOAK = First-Of-A-Kind

For a FOAK facility:

- **Experience in the construction and operation of this specific design is non-existent or very limited**
- **The design contains a number of new technological features or operating approaches that have not yet been fully proven in an integrated manner and in commercial use**
- **Experience with the application of industrial standards for these specific approaches remains new for both licensees and regulators**
- **Deployment approaches may vary from traditional methodologies, requiring a more novel approach to licensing**

What is a FOAK?

A FOAK facility:

- Is manufactured and constructed in a more traditional manner, contrary to the long-term objective of factory manufacturing, until construction and manufacturing practices are optimized for mass production
- May be a commercial facility projected to operate over a full lifecycle. Alternatively, depending on the licensees’ objectives, the FOAK reactor may see earlier removal from service and alternate decommissioning strategies.

Licensing of a FOAK

Key questions

- **Adequacy of safety demonstration**
- The regulatory framework

What is a sufficient demonstration of safety of the new features, how to manage the uncertainties?

- Possible approaches:
  - more conservatism in the design, increased design margins (e.g., thicker concrete, more margins in reactivity control, more heat removal capacity, etc.)
  - additional safety features (e.g., supplementary active shutdown means)
  - more stringent/conservative operational limits (e.g., limiting operation to something less than full power)
  - more extensive commissioning testing than in NOAKs

Licensing a FOAK

Key questions
- **Adequacy of safety demonstration**
- The regulatory framework

What is a sufficient demonstration of safety of the new features, how to manage the uncertainties? (continued)

- Possible approaches:
  - Start discussing the required safety demonstration already at early phase (both with the licensee and internally within the RB).
    - What is required from the licensee?
    - Does to regulatory body want to perform/order independent analyses or experiments to confirm the results of the licensee’s demonstration?
    - Especially experimental demonstration takes time.

Licensing a FOAK

Key questions
- Adequacy of safety demonstration
- **The regulatory framework**

Does the regulatory approach support licensing of FOAK facility

- Are the regulatory requirements up-to-date and applicable to new technologies?
- Is the regulatory framework flexible, e.g. allowing the use of alternative approaches if an equivalent or superior level of safety is reached?

Licensing a FOAK

In a FOAK project, delays are possible. Not only due to regulatory review, but due to challenges in manufacturing, construction or testing. First attempts (e.g. in manufacturing) are not always successful, analyses and testing can provide unexpected results. The regulatory body needs to have the authority to require safety issues to be solved before proceeding, despite of pressure to keep the schedule.

Photo: STUK

Licensing a FOAK

Although FOAK refers to the facility, organisations may be ”FOAK”, too.

- With the emergence of SMRs, new vendors, manufacturers and license applicants may emerge.
- The new organisations do not necessarily have much experience or fundamental understanding of safety questions related to nuclear energy.
- The regulatory body itself may be recently established and without previous licensing experience.
- Even more experienced RBs may not have competence of all SMR technologies.

Licensing a FOAK

Possible approaches to “FOAK” organizations

- Regulatory expectations should be clear.
- The regulatory body should ensure the license applicant meet the expectations (e.g. has adequate competency and is able to oversee, control and support the subcontractors).
- The regulatory body can support the other organizations by explaining the regulatory framework and the regulatory requirements.
- Regulators must also consider the amount of experience they themself have with respect to technologies that are being assessed. Targeted training programs to help develop regulatory knowledge should be considered if needed.
- Cooperation with the regulatory body of the country of origin (or other countries licensing the same design) is a good way to familiarize with the design and the related safety issues.

NOAK (N^th^-Of-A-Kind)

As operating experience is cumulated, it is probable that changes to the design are made. It may take some reactor generations before the design stabilizes.

- It is good to have flexibility in the regulatory approach; even if the FOAK design is accepted, the regulator should have an approach that enables and supports changes that improve safety.
- The cumulative effect of changes must be evaluated.

Key Regulatory Interventions (KRIs)

KRIs

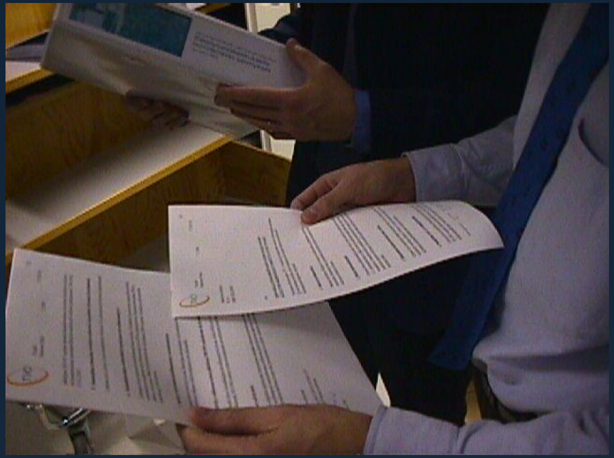
In everyday language, KRIs are often called hold-points.

- KRI is a point in the life cycle of the facility where the regulatory body checks (by review, assessment, inspection or combination of these) something either after some activity and/or before activities can continue.
- Objective of KRIs is for the regulatory body to establish regulatory control over all activities and facilities where safety is concerned. KRIs enable effective regulatory control at important phases of the life cycle.

KRIs

KRIs can have different forms; it can be for example

- a thorough safety assessment of the facility and the operating organisation (e.g. construction license or operating license) or
- a more limited assessment (e.g. assessment of some chosen design feature or approach)
- inspection related to certain activity (e.g. readiness to pour first concrete) or
- granting a permit, based both on review of documentation and inspection(s) on the site, for an important step (e.g. for first ciriticality).



Photos:STUK

KRIs

General principles

- Main KRIs are usually defined in the national regulations (for example the construction and operating licenses).
- The regulatory body may define other KRIs case-by-case for new build projects, depending on the project and facility.
  - It is good to have some flexibility in the regulatory framework for determining the KRIs as the facilities and projects may be different.

In any case, the licensing process should be understood by the parties concerned and it should be predictable - well defined, clear, transparent and traceable.

How to choose KRIs?

Factors to consider

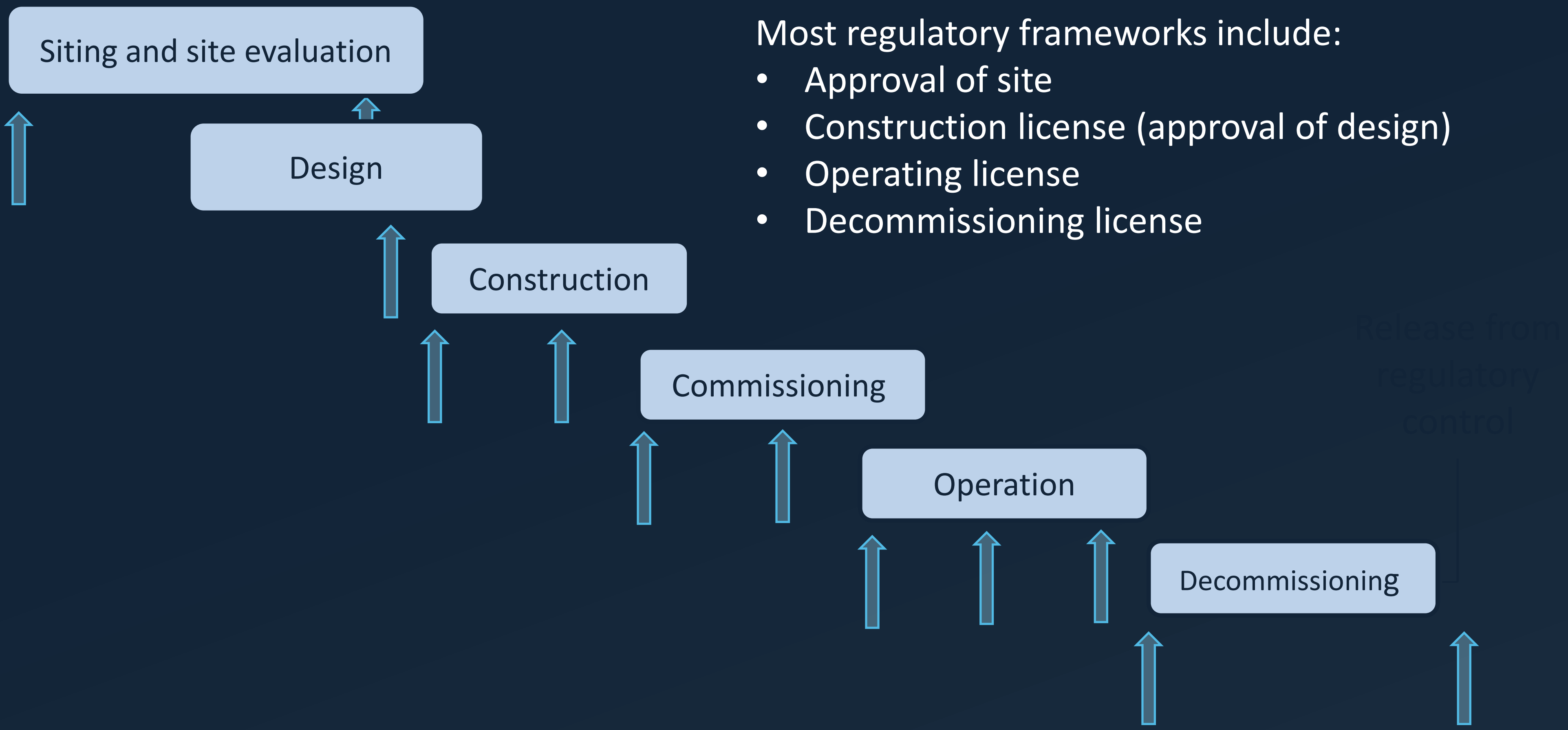
- The level of risk or the safety significance of the lifecycle step being considered
- Constraints (e.g., access limitations after a certain stage of construction)
- Impossibility or difficulty to repeat the activity if not successful at first attempt
- The novelty or lack of proven-ness

How to choose KRIs?

Steps where regulatory bodys typically have KRIs

- KRIs are usually set in steps where something is changing, like phase of life cycle or responsible organisation:
  - Start of new activity (construction, installations, commissioning, operation etc.)
  - Before (readiness check) and/or after (verifying results) major activities like pouring first concrete or proceeding from one phase of commissioning to the next one
  - Turnovers of major project activities from one organization to another
  - Steps where the risk caused by the facility increases or where new kind of measures are needed to mitigate risks
    - Fuel arrival onsite
    - Loading of fuel into the reactor core
    - First criticality

Typical life cycle of a traditional NPP



Most regulatory frameworks include:

- Approval of site
- Construction license (approval of design)
- Operating license
- Decommissioning license

Potential life cycle of an SMR

Siting and site evaluation

Design

Design, site-specific

Construction (at factory)

Construction, on-site

Commissioning (at factory)

Commissioning on-site

Operation (factory) for factory fuelled reactors

Operation (transport) for factory fuelled reactors

Operation

Decommissioning

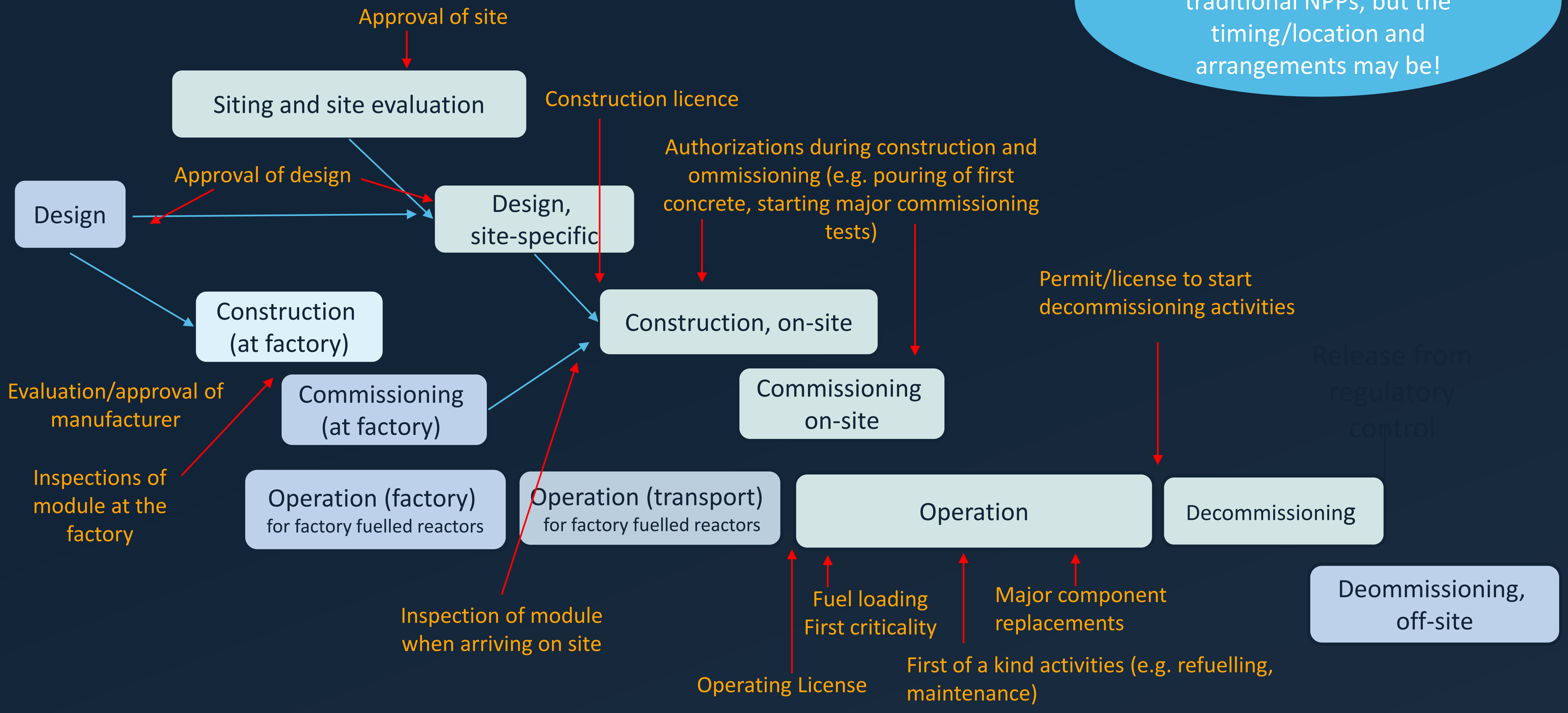
Deommissioning, off-site

For SMR

- Construction, commissioning and even operation can take place both at the factory and on site
- Off-site construction and commissioning may have been completed before the licensee launches its project.
- There may be several licensees over the lifetime

Potential KRIs for SMRs

The content of the SMR KRIs is not very different from traditional NPPs, but the timing/location and arrangements may be!



Serial production challenges traditional oversight

If serial production of SMRs is achieved, main components and even a whole reactor module may have been manufactured, assembled and tested before the involvement of the future licensee of regulator

- This challenges the traditional oversight of the activities both by the licensee and the regulator
- New ways to confirm the quality of the end-products must be thought of.

MDEP produced in 2018 a paper for crediting commissioning tests performed at the first plant only
Common Position on FPOT

Licensing multi-module facilities

- Safety aspect of multi-module facilities are (were) discussed by the Design and Safety analyses WG.
- Licensing WG (and this presentation) focus on the licensing process; licensing should ensure the safety aspects are considered and taken into account in appropriate manner.

Licensing multi-module facilities

Differences compared to typical present NPPs with several units:

- Modules may be linked with each other much closer. They may
  - Share several systems (including safety systems);
  - Be located in the same building;
  - Feed the same process (e.g. common turbine);
  - Be operated by one crew from a common control room.

↳ One module may affect the operation of another (through the process or shared systems)

↳ CCFs affecting several modules may be more probable than with more individual units

One licence or several licences?

- Regulators have different approaches in whether to issue an individual license for each reactor or one license covering all the modules of a multi-module facility.
- Factors to be considered
  - ➢ **Issues concerning whole facility or site must be managed**
    - Some issues concern the whole facility or site and they should be covered even if all modules have their own license (for example emergency arrangements or security arrangements)
    - Even if modules are constructed and licensed one-by-one, licensing is facilitated if the ultimate number of modules is known in the beginning.

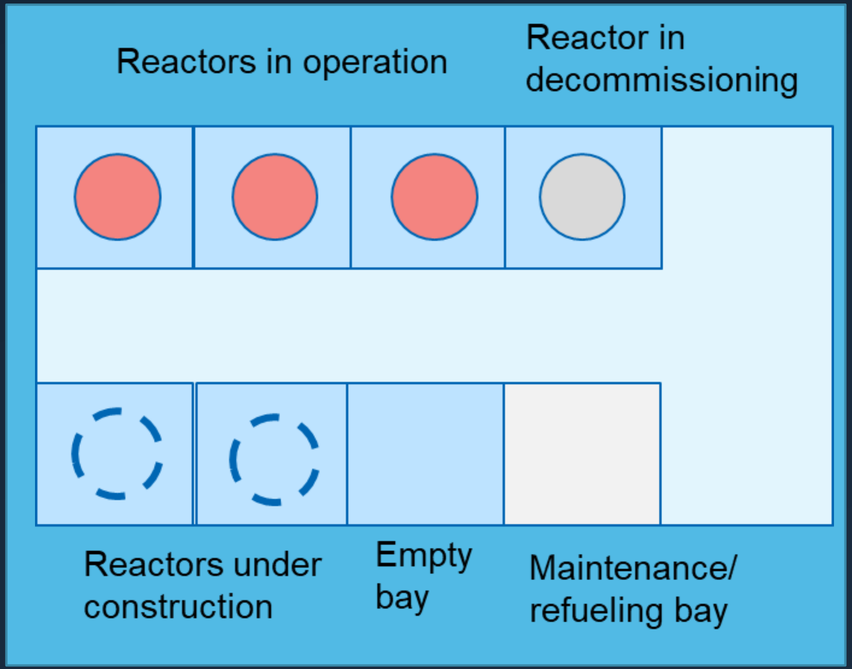
One licence or several licences?

- Factors to be considered (continued)
  - ➢ **Different phases of the life cycle**
    - Multi-module facility may be implemented in stages → Licensing should enable adding new modules or decommissioning modules in a feasible way
    - A module may need to be decommissioned earlier than planned (due to failures or an accident) → Licensing should allow managing unexpected changes in the life cycle of a module while other modules continue as planned.

One licence of several licences?

- Factors to be considered (continued)
  - ➢ **Transferring modules**
    - A module may be transferred either within site or out of the site for maintenance or refueling.
    - After maintenance or refueling, the reactor module may be placed in a different bay than where it was before the transfer
    - A loaded module can removed from site for decommissioning and it may be replaced by a new module

→how these situations are manged in the licensing?



Specific topics

Multi-module facilities have some features that are new or are highlighted compared to single units. In the licensing, the regulatory body should confirm that the licensee

- Has configuration management
- Systematically considers HFE
- Has ensured shared systems do not endanger safety (e.g. have sufficient capacity, CCF risk is managed)
- Has considered possible multi-module effects in PIEs
- Has considered multi-module events in emergency plans and security plans

HFE

- Even in traditional NPPs it has happened that work (walkdowns, maintenance, repair) has been carried out on wrong unit.
- For the operators the work-load and maintaining situational awareness are challenges when operating several reactors simultaneously.

⇒ Risk to both personal and nuclear safety!

- In multi-module SMRs these issues are highlighted.

⇒ **Systematic use of HFE through the lifetime of the facility will help to reduce the risks.**

Configuration Management

- The modules may have differences:
  - design differences if modules are added in stages;
  - differences created during operation (repairs, modifications - the equipment suppliers can change, technology evolves etc.)
- Technical documentation, operating procedures, control room displays etc. must be kept up-to-date.
- Personnel must be aware of the differences between the modules.

A rigorous configuration management is essential for safe operation!

Shared Control Rooms

- Differences of control rooms of multi-module/unit facilities compared to traditional NPPs may include
  - operating several reactors from a common control room;
  - operating several reactors by one team;
  - non-fixed configuration: adding new modules/units later on or changing the location of the modules/units within the facility.
- For SMR is general
  - Due to use of passive systems, long grace periods and increased role of automation, the duties of the operators may differ from traditional NPPs.
  - The amount of control room staff is minimized.

Shared Control Rooms

- Regulators have different licensing approaches to control rooms. Some countries may require regulatory approvals related to control rooms, the approvals can consider, for example, control room equipment, the persons working as operators or validation of the chosen concept.
- Even if no approvals are required, typically the regulatory body expects to see some demonstration that the facility can be safely operated by the chosen control room concept.
- Operating a multi-module facility from a shared control room have new features that should be considered in the licensing.

The regulator should ensure in the licensing process that the safety of the chosen control room concept is adequately demonstrated.

Questions?

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Part II:

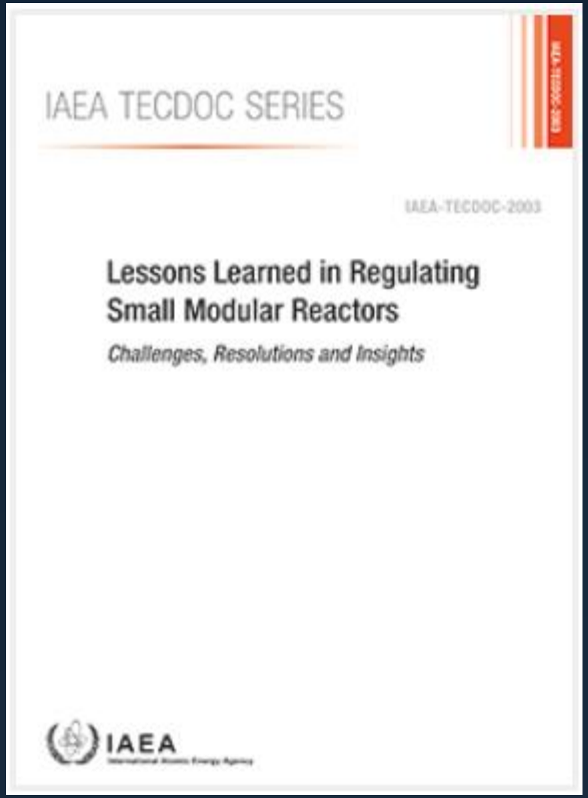
International Experience in the Regulation of small modular reactors

International Experience in the Regulation of Small Modular Reactors

1. Background
2. Aspects Related to Legal and Regulatory Framework
3. Aspects Related to Safety Design and Analysis
4. Other Regulatory Challenges

Background

- IAEA-TECDOC-2003 created on the suggestion of the SMR Regulators' Forum
- Currently limited international experience in regulating and licensing SMRs
- A wide range of approaches to the regulation of SMR
- Questionnaire sent to 10 member states' regulatory bodies



Background – TECDOC-2003 Lessons Learned in Regulating SMRs

Objective – to present existing experience gained by regulatory bodies on the regulation of SMRs

- Scope
  - Nuclear reactors of power of typically <300 MWe or <1000 MWt per reactor.
  - Reactors designed for commercial use.
  - Reactors designed to allow addition of multiple modules in close proximity to the same infrastructure.
  - Novel designs that have not been widely analysed or licensed by regulatory bodies.
  - Reactors that may be underwater, land-based or floating nuclear power plants (FNPPs).

Legal Framework

- IAEA safety standards and legal framework in Member States were developed and established in the context of deploying large light water reactors

- Two broad types of approach, with some variations, to regulate the safety and security of nuclear installations
  - Prescriptive approach – based on legal requirements to comply with specific rules by means that are specified in laws and regulations
  - Goal-setting (performance based) – legal frameworks in which the legal requirement is broadly set as ‘safety goals’ to be achieved by the applicant/licensee

Legal Framework

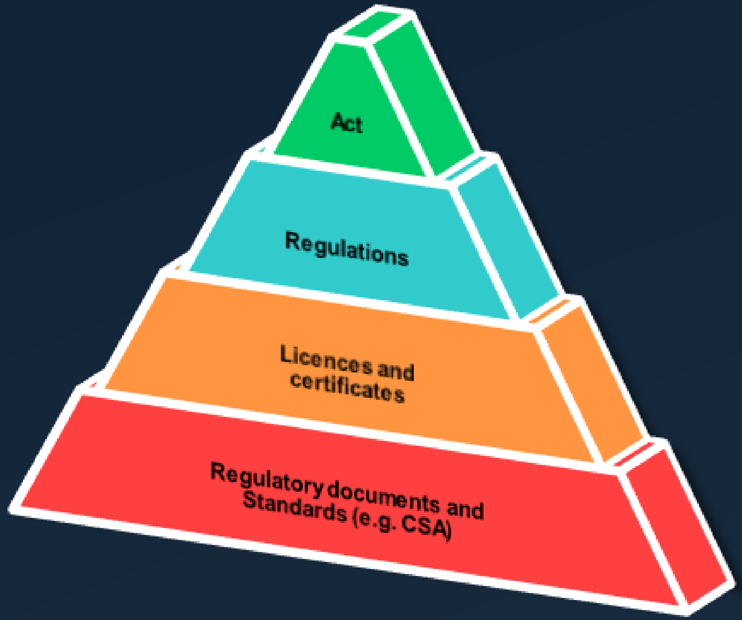
- Experiences/Challenges

  - Operating under goal-setting legal frameworks reported that no or very limited changes were needed to enable the regulation of SMRs.
    - Goals are expressed on a technology-neutral basis
  - Member State participants using rule-based frameworks and approaches to regulation (which are not technology neutral) reported that changes have been made or will be necessary to enable the regulation of new technology
  - Limited or no need for changes at the legal framework and regulations level were reported when the requirements and regulations already cover or were specifically developed to cover the technology under consideration
    - e.g. LWR technology when considering LWR-SMR projects

Legal Framework

Looking Ahead

- National legislative frameworks that are technology specific need to be adjusted and/or be formulated in a more technology neutral manner to facilitate the deployment of SMRs
  - U.S. Congress passed The Nuclear Energy Innovation and Modernization Act (NEIMA)

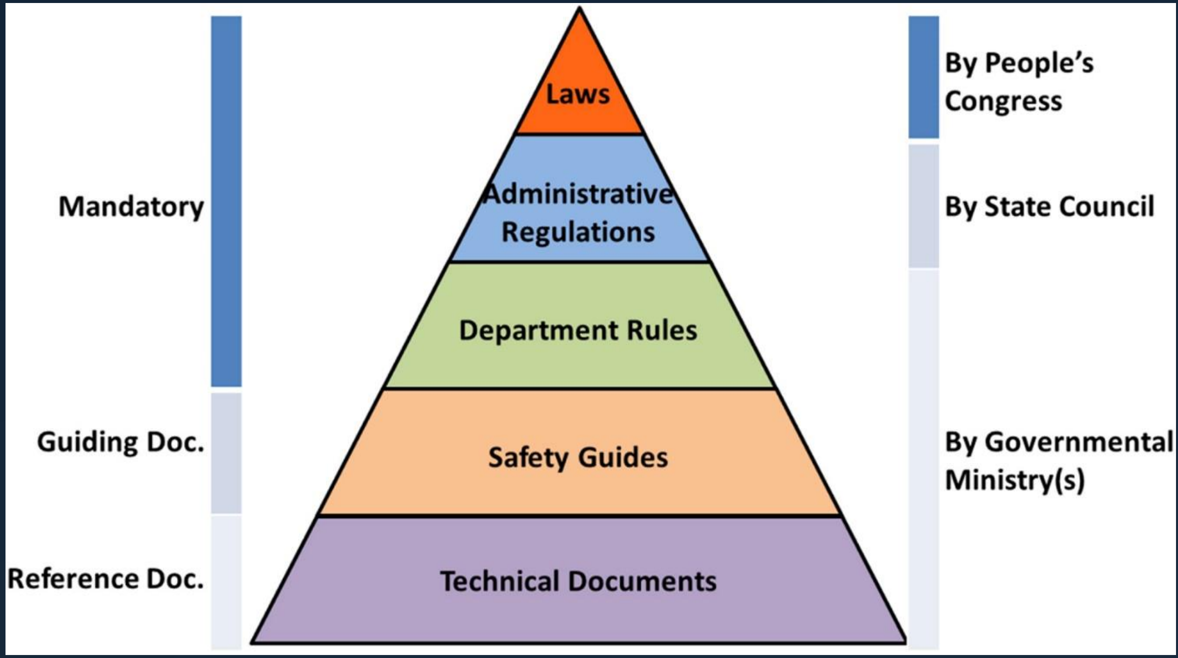


CNSC's regulatory framework

Regulations and Guidance

Requirement 32 of IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Governmental, Legal and Regulatory Framework for Safety [2] states:

- “The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based.”



China’s regulatory framework

Regulations and Guidance

Experiences / Challenges

- Technology-neutral and goal setting regulatory regimes – limited need for changes or new regulations
- Challenge in providing applicant guidance on the processes needed to demonstrate compliance
- New reactor types have limited operating experience and international safety standards have not been developed.
- Argentina reported that:
  - The regulatory body is reviewing the country’s regulatory requirements in parallel with regulatory reviews.
  - To fill in gaps in the national requirements or guidelines, the regulatory body used international standards were used as a guide

Licensing Process

- Challenges / Experiences
  - No tested or applied process for SMRs
  - Processes being developed and implemented once the application is received and can be assessed by the regulatory body
  - Process needs to be sufficiently flexible
  - Pre-licensing approach (UK, Canada, China, Argentina) tend to increase flexibility and adapt to maturity of development while remaining consistent with other approaches.
  - UK allows applicants to use submissions to other regulatory bodies, supplemented to meet UK requirements.

Regulatory Approach

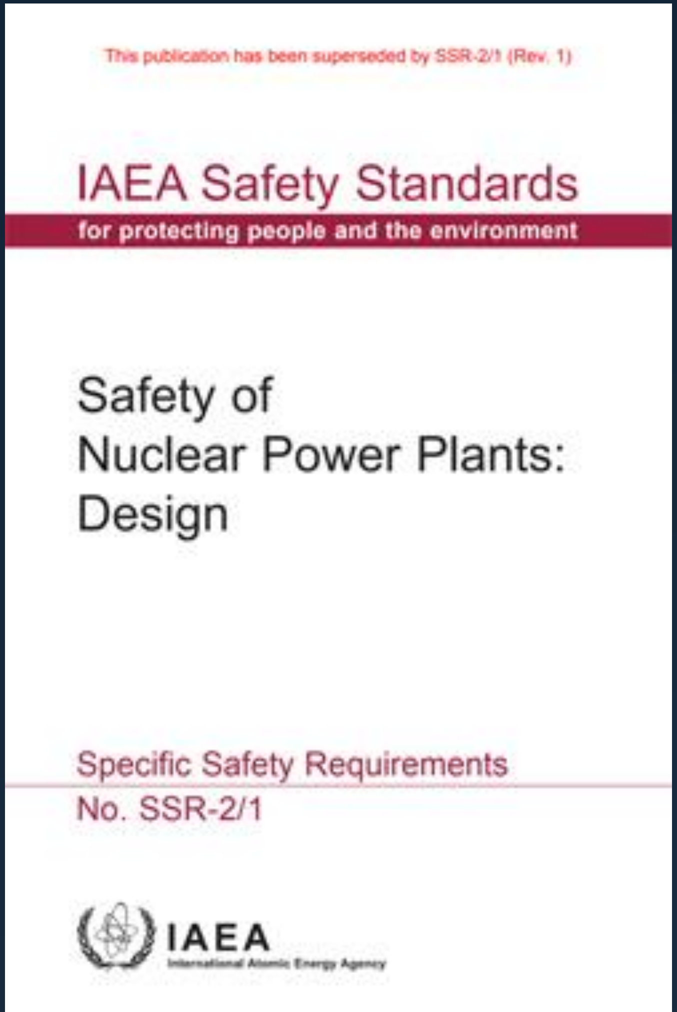
- Challenges / Experiences
  - Member State participants reported limited or no changes to the approach for reviewing documentation as part of the authorization process.
  - Argentina emphasized the benefit of early engagement in the goal-setting regulatory approach
  - Russia reported that the main difference between the floating SMRs and land-based ones was the absence of a separate ‘siting’ stage

ASPECTS RELATED TO SAFETY DESIGN AND ANALYSIS

- As part of the regulatory process, the regulatory body needs to review and assess the installation's design and analyse the documentation provided by the applicant/licensee.

•Paragraph 2.9 of SSR-2/1 (Rev. 1) [3] states:

- "…a comprehensive safety assessment of the design is required to be carried out. Its objective is to identify all possible sources of radiation and to evaluate possible doses that could be received by workers at the installation and by members of the public, as well as possible effects on the environment, as a result of operation of the plant."



Safety Functions

- Three fundamental Safety Functions:
  - Reactivity control function
  - Heat removal function
  - Confinement function

  Requirements 46, 51 and 55 of SSR-2/1

Reactivity Control Function

- Requirements for reactivity control:
  - Operational safety limits are to be established from safety analyses.
  - Specific variables are measured by the reactor protection system and the shutdown systems are activated if predetermined set points are reached.
  - Reactivity control methods meet the seismic requirements.

- Shutdown capability:
  - para. 6.9 of SSR-2/1 (Rev.1) [3],
    - two diverse and independent systems for shutdown with adequate safety margin are provided;
    - one of the systems is expected to be fast acting and the other needs to provide adequate reliability in DEC.

Reactivity Control Function

- Challenges / experiences
  - In general, regulations for the design of NPPs are applicable to SMRs.
  - Vendors claim that their proposed designs are: simpler; incorporate passive features and inherent safety; and can fulfil of safety functions by diverse means.
  - Robust demonstration of the effectiveness of passive systems is necessary, along with an extensive verification of the reliability claims and a robust demonstration of conservative sub-criticality.
  - Use of models, codes and software to perform V&V to demonstrate safety margin
  - **Two independent and diverse shutdown systems are still required to be provided.**

Safety Analysis

- Topics considered:
- Initiating events
- External events
- Defence in depth
- Core damage and severe accidents
- Sharing of safety systems and features
- Safety objectives for multi-unit facilities
- Accident source term
- Computer codes

Sharing of safety systems and features

- Requirement 33 of SSR-2/1 (Rev.1) [3] states that: “Each unit of a multiple unit nuclear power plant shall have its own safety systems and shall have its own safety features for design extension conditions.”

- In exceptional cases sharing of SSCs important to safety is permitted if it can be demonstrated that it is not in detrimental to nuclear safety.

Sharing of safety systems and features

- Argentina and UK - requirements in line with the IAEA safety standards and do not allow sharing of safety systems for DBAs
- Canada - is possible to have shared SSCs, but must demonstrate that the safety functions can be achieved even with failure of an SSC in another unit
- Russia – for FNPP in the limited space of a vessel, some systems or their components can be used for two reactors but they have redundancy

Safety Design

- Topics Considered:
  - Safety classification of SSCs
  - Novel/innovative design features
  - Qualification of SSCs
  - Industry codes and standards

Novel Design Features

- Passive cooling mechanisms:
  - Natural circulation;
  - Gravity driven injection.
- Integral design (incorporation of primary system components into a single vessel).
- Non-traditional barriers to fission product release.
- Unique fuel designs (e.g. ceramic materials, molten salt fuel).
- Passive safety systems.

Novel Design Features

- Challenges / experiences
  - Vendors and applicants followed the route of a prototype and test facilities to inform the design and safety demonstration of new reactor designs
  - Requirements and guidance are necessary for qualification programmes of new materials and features applicable to SMR designs

Other Regulatory Challenges

- Regulatory approach for suppliers
- On-site inspections
- Inspection of reactor internals, civil structures, and structures, systems and components
- Emergency planning zone
- Staffing levels of multi-unit plants
- Occupational exposure
- Safeguards
- Nuclear security

Regulatory approach for suppliers

- Increased role of the manufacturer/supplier, regulatory inspections performed in the factory are important and new guidance or procedures for such inspections may need to be developed
- Important to have safety management programmes during design, manufacturing, construction, commissioning, operation, and decommissioning
- Argentina - regulatory body only conducts inspections and audits on the licensee. It is the responsibility of the licensee to oversee that the supplier management programme

Optional CNSC Pre-Licensing Processes

Role of a Vendor

A vendor is part of the licensee's Procurement process.
They supply services and products to applicants.

Potential Applicant for a Project

Licensing involves an **applicant** for a **licence** who is proposing to build and operate a vendor's design. Usually an owner/operator of a plant, responsible for the safe conduct of the activities being licensed.

Vendor Design Review (VDR)

Application Assessment Strategy

SECTION 4 OF REGDOC-1.1.5, *SUPPLEMENTAL INFORMATION FOR SMALL MODULAR REACTOR PROPONENTS*

The Vendor Design Review Process

An opportunity for the Vendor to:

- Verify its understanding of Canadian requirements
- Obtain early feedback from CNSC staff on how:
  - Canadian requirements are being addressed in design and safety analysis
  - New design features and approaches are being addressed

An opportunity for CNSC staff to:

- Develop an understanding of both the vendor’s organization and its design concept
- Anticipate regulatory challenges before a licensing process is triggered