# **ITER Licensing**

C. Gordon and the ITER Site Proponent Teams for Cadarache, Clarington, Rokkasho and Vandellos



The Way to Fusion Energy

20th IAEA Fusion Energy Conference 1-6 November 2004, Vilamoura, Portugal







# **ITER Licensing: Outline**

- Introduction and Background
  - Why does ITER need to be licensed?
  - What does licensing entail?
  - What is unusual about licensing ITER?
  - What have we done to prepare for licensing ITER?
- Preparations for Licensing ITER
  - Parties' Designated Safety Representative meetings
  - Joint Assessment of Specific Sites
  - Discussions with regulators
- Regulatory Approval Process
- Observations from IT Perspective
- Summary



# Why does ITER need to be licensed? (1/2)

- Goal: demonstrate fusion's safety & environmental characteristics
  - Low fuel inventory
  - Ease of burn termination; self-limiting power level
  - Low power & energy densities; low energy inventories
  - Large heat transfer surfaces & heat sinks
  - Confinement barriers exist and must anyway be leak-tight

### • Comprehensive & conservative design assessments show goal is met:

- During normal operation, potential additional doses to members of the public (i.e. most exposed individual), < 1% of natural background.</li>
- For the most severe off-normal events, additional doses (most exposed individual) comparable to average annual natural background (i.e. ~2 mSv/a).
- Even under worst imaginable hypothetical combination of events, there is no technical justification for dependence on public evacuation.

### If ITER is so safe, why does it need to be licensed?

# Why does ITER need to be licensed? (2/2)

#### What needs to be regulated?

Implementation of IAEA Basic Safety Standards requires a Regulatory Authority be established by Government to regulate introduction and conduct of any practice involving sources of radiation, e.g.

- sources of ionizing radiation; their production, use, import and export;
- nuclear and irradiation facilities for medical, industrial and research purposes;

by issuing, amending, suspending or revoking authorisations, subject to any necessary conditions.

#### What does ITER want to do?

- •Demonstrate extended burn of DT plasmas, with steady state as the ultimate goal.
- Integrate and test all essential fusion power reactor technologies and components.
- •Demonstrate safety and environmental acceptability of fusion.

Tritium, activation products and radiation sources during operation.

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# **ITER will need regulatory approval**

# What does licensing entail?

"Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety -Requirements" IAEA Safety Standards Series GS-R-1

- Prior to granting authorisation, the applicant/operator is required to submit a detailed demonstration of safety, which is reviewed and assessed by the regulatory body in accordance with its procedures. The extent of control applied should be commensurate with the potential magnitude and nature of the hazard presented.
- The review and assessment of the operator's technical submission is performed by the regulatory body to satisfy itself that:
  - the information demonstrates the safety of the facility or proposed activity;
  - the information is accurate and sufficient to enable confirmation of compliance with regulatory requirements; and
  - the technical solutions, and in particular any novel ones, have been proven or qualified by experience or testing or both, and are capable of achieving the required level of safety.
- However, the operator has the responsibility for ensuring safety of public, workers and environment.



# What is unusual about licensing ITER?

- ITER will be the first-of-a-kind, large-scale, reactor-like, fusion facility; i.e., more hazardous than existing fusion experiments.
- Most regulators are unfamiliar with fusion. There are no existing standards that address all aspects that need to be regulated and that are fully appropriate for fusion. ITER will set a precedent.
- In addition to radiation hazards, there are other hazards e.g. beryllium, magnetic fields, cryogens, etc. although these are not unique to ITER. This will require regulation of multiple hazards.
- ITER will be implemented as an international project. Regulator needs to address off-shore suppliers, working language, etc.
- Design has preceded site selection. There are various safety approaches that can meet safety objectives, there are also different choices or emphases in implementation to meet a particular country's regulations.



# Licensing without a Site

- It is a project requirement that ITER be able to be sited in any of the participant countries with only minor design changes.
- In the absence of an actual site the project adopted:
  - generic site consistent with the ITER site requirements and design assumptions,
  - ITER-specific safety approach, and
  - non-site-specific safety documentation.

![](_page_7_Figure_6.jpeg)

# What have we done to prepare for licensing ITER?

![](_page_8_Figure_1.jpeg)

![](_page_8_Picture_2.jpeg)

# Parties' Designated Safety Representative Meetings

- Representatives of Parties' regulatory authorities, site proponents, and ITER International Team Leader met to jointly consider issues for licensing in Garching (October 2000), Tokyo (May 2001) and Cadarache (June 2002).
- Confirmed basic approach: defence-in-depth, as low as reasonably achievable (ALARA), demonstrate dose limits.
- Quality Assurance programme is fundamental; covering both procurement and licensing processes.
- Need for 'design authority' and legal continuity throughout licensing process.
- Need to respect international nature by host authority and all project participants.

![](_page_9_Picture_7.jpeg)

## **Proposed Sites**

![](_page_10_Picture_1.jpeg)

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# **Joint Assessment of Specific Sites**

- Looked at characteristics of sites against an agreed set of criteria.
   One of the criteria addressed licensing aspects, specifically:
  - Regulatory framework
  - Safety design approach /guidelines
  - Steps of licensing procedures; Road map for licensing
  - Design standards, quality assurance, etc.
  - Restrictions on long lead procurement, site preparation, and financing activities
- Of particular importance for a first-of-a-kind facility like ITER : "Well defined licensing and decommissioning processes were ascertained for all the Sites."
- Provided an opportunity to obtain a common, more detailed understanding of what would be required for licensing at the specific sites and to provide confidence to the Parties that regulatory activities for the site would not present an undue risk of cost increases or schedule delays.

![](_page_11_Picture_10.jpeg)

## **Discussions with Regulators**

Site	Responsible Institution	Regulatory Agency	Comment
Cadarache, France	Commissariat à l'Energie Atomique (CEA)	Autorité de sûreté nucléaire (ASN)	<ul> <li>"Dossier d'Options de Sûreté" submitted and comments received from ASN.</li> <li>Discussions are underway.</li> </ul>
Rokkasho, Japan	Japan Atomic Energy Research Institute (JAERI)	Ministry of Education, Culture, Sports, Science and Technology (MEXT)	<ul> <li>Basic requirements for safety established by MEXT based on ITER unique features.</li> <li>Informal discussions are underway.</li> </ul>
Clarington, Canada	Iter Institute (established for licensing in Canada)	Canadian Nuclear Safety Commission (CNSC)	<ul> <li>Letter of Intent submitted.</li> <li>Licensing Plan submitted.</li> <li>Scope of Environmental Assessment issued by CNSC.</li> <li>Discussions were underway.</li> </ul>
Vandellos, Spain	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)	Consejo de Seguridad Nuclear (CSN),	<ul> <li>Site Permit documentation submitted.</li> <li>Summary memorandum for Environmental Impact Assessment submitted.</li> <li>Discussions were underway.</li> </ul>

# **Regulatory Approval Process**

![](_page_13_Figure_1.jpeg)

Cadarache: "Débat Public", countrywide discussion on socio-economic and/or environmental consequences during siting. "Dossier d'Options de Sûreté" to define safety functions, identify risks, describe means for risk mitigation / minimisation when major conceptual choices completed. Rokkasho: confirm design basis for construction license, confirm design specifications during construction, inspection during operation Clarington: Operating licence for limited period (2-5 years), operation etc. reviewed for renewal. Vandellos: description of site and outline of planned facility for Site Permit.

![](_page_13_Picture_5.jpeg)

# **ITER Specific Issues**

- Working language for ITER is English and that of regulatory authority is not.
  - Formally communicate with the regulatory authority in their native language so that translation issues (such as review and approval of regulatory submissions by the Design Authority) are managed within the ITER team.
  - Maintaining a consistent set of regulatory documents in two languages throughout life of the project will be a challenge for configuration management, but essential to operate ITER safely and within authorised limits.
- **Specific issues** raised by regulatory authorities are similar and include:
  - experience feedback
  - clarification of radioactive source terms and how these will be monitored.
  - elaboration of the confinement design and monitoring and bases for these.
  - potential for beryllium steam/air reactions and resultant hydrogen production.
  - provision for dust explosions.
  - fire hazard analyses and fire protection schemes.
  - provisions for toxic materials (such as beryllium).

# ITER Specific Issue Experience Feedback

- ITER will be a first-of-a-kind facility without agreed international standards to use in licensing.
- There are different hazards that need to be regulated (radiological, beryllium, cryogens, etc.).

#### However:

- There exist facilities with similar hazards which provide operational feedback to the ITER design process and provide confidence in ITER's safety:
  - Many large tokamaks have operated, including superconducting tokamaks
  - JET and TFTR are large tokamaks that have used tritium
  - Many tritium research and industrial facilities have used comparable technologies and handled comparable inventories (TPL in Japan, FZK in Germany, TRF in Canada)
  - Many facilities have safely handled beryllium (BR3 in Belgium), cryogens and magnetic fields (CERN).
- A staged or step-by-step approach to operation will be used to incorporate ITER operational experience.

# ITER Specific Issue Radioactive Source Terms

Knowledge of radioactive source terms is essential for safety assessments.

- Difficult to estimate in advance with a high degree of confidence tritium retention rate, dust production rate, dust characteristics (size, shape, composition), etc.
- **Step-by-step approach** is essential in ITER operation and licensing.
  - <u>Design and construction phase</u>: initial limits & guidelines based on current understanding; identification of possible measurement & removal techniques; R&D to better define limits, techniques & options for regulatory submissions.
  - <u>HH phase</u>: measurements to validate dust characteristics & distribution, codeposition characteristics, analytical models (for production, mobilisation, etc.), measurement & removal techniques.
  - <u>DD and DT phases</u>: on-going measurements to ensure limits are not exceeded; on-going validation of measurements.
- Objectives and means to achieve these need to be agreed in advance of operation; limits to achieve these will be conservative to begin with, to address uncertainties.
- It should be possible to update limits and improve techniques in a manner acceptable to regulatory authorities as uncertainties are reduced based on on-going experience.

![](_page_16_Picture_10.jpeg)

# **ITER Licensing: Summary**

- The ITER safety case has been developed in conjunction with an international team of safety experts for over a decade.
- For at least the past five years, discussions have taken place with the actual regulatory authorities who would have been in charge of licensing ITER for their country.
- These initial steps in licensing ITER have allowed for refining the safety case and provide confidence that the design and safety approach will be licensable.
- With site-specific licensing underway, the necessary regulatory submissions have been defined and are well on the way to being completed. There is still work to be done and details to be sorted out.
- The informal international discussions to bring both the proponent and regulatory authority up to a common level of understanding have laid the foundation for a licensing process that should proceed smoothly.

![](_page_17_Picture_7.jpeg)