

6th INPRO Dialogue Forum on Global Nuclear Energy Sustainability:
**Licensing and Safety Issues for Small and Medium-sized
Nuclear Power Reactors (SMRs)**

29 July - 2 August 2013

IAEA Headquarters, Vienna, Austria

Discussion Group 2:
Siting Considerations for SMRs

Friday August 2 Final Report to Plenary

Group Leader: Mr. Marcel de Vos

Co-Leader: Dr. Ferhat Aziz

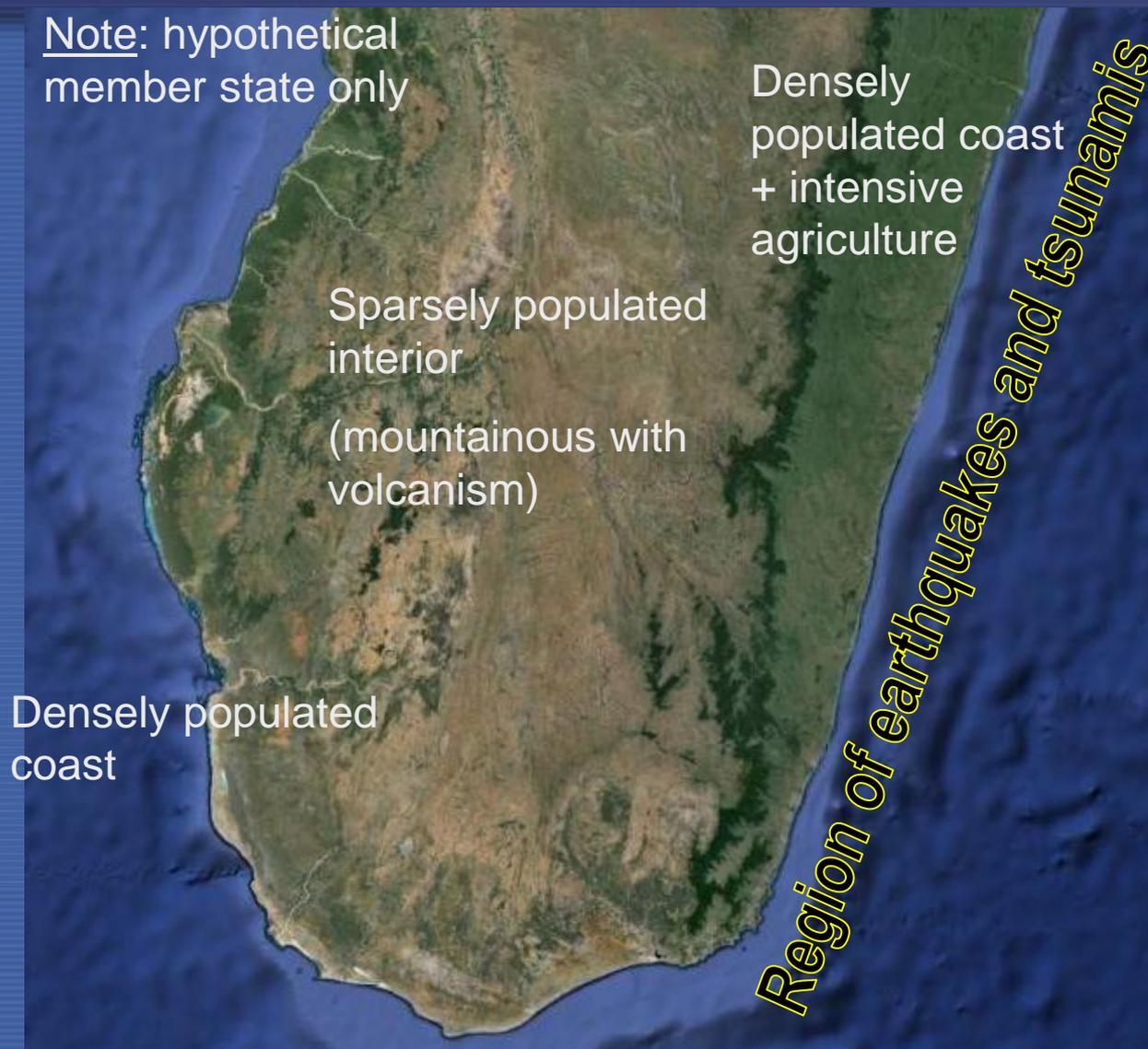
Purpose of Case Studies...

- Illustrate how SMR's could alter the traditional picture of a Nuclear Plant site
- Siting conditions in case studies challenge the design and the ability to provide adequate emergency response
- Conditions in case studies also challenge existing siting requirements to see if any adjustments need to be made to accommodate issues that arise in the case studies

Case study #1: Closer to dense population centres with stressed infrastructure



Note: hypothetical member state only



Densely populated coast + intensive agriculture

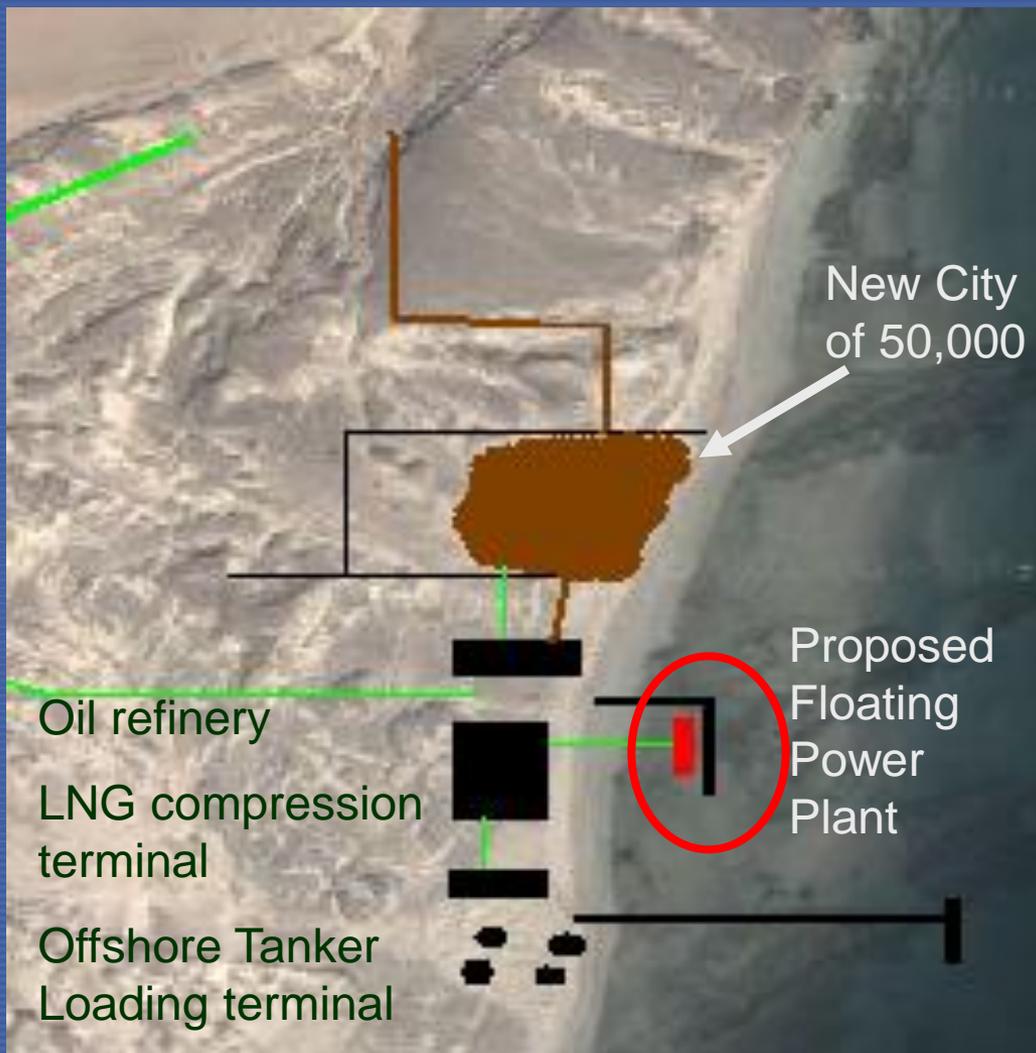
Sparsely populated interior
(mountainous with volcanism)

Densely populated coast

Region of earthquakes and tsunamis

- poor land-use control (land use policies under development due to regional overcrowding)
- grid is regional with some interconnects. Typical existing thermal plants are 100-200 MWe each but also many small hydro-electric sources in use
- Cooling water only available from ocean
- Member state has good history and infrastructure for characterising external hazards.

Case study #2: Adjacent to industrial facilities that present challenges to the SMR's safety case



- region chosen for site is underserved and underdeveloped
- SMR to be marine-based power source for new industrial park (promote regional growth)
- Member state has low population density
- Seasonal monsoons and sporadic history of tsunamis from offshore events
- Poorly documented seismic data
- Access to national grid but grid is unreliable
- Power plant to supply any excess to national grid

Case study #3: very small facilities in remote regions where infrastructure is poor and emergency response time can see extended delays



- no grid – all power is generated locally (diesel sets)
- Standardized 10 MWe design being considered for each site – sealed core – no on-site refuelling
- limited skeleton staff on site to operate and maintain each facility
- no major road infrastructure between sites (only air or ship access)
- No significant emergency services in the region – local services are very light
- **Evacuation is not an option**
- Extreme seasonal weather frequently delays transport

The following IAEA Safety Standards reviewed against case studies



DS-433 *Safety Aspects in Siting for Nuclear Installations* – used to establish a process to initially investigate candidate sites and narrow down to one or more final sites to be investigated further

NS-R-3 *Site Evaluation for Nuclear Installations* and supporting safety guides – used for building and maintaining a site suitability case – site characterisation data input informs the safety case over the life of the facility

- Supporting safety guides were not reviewed due to time constraints.

Determining source-terms for non-water cooled SMRs or novel fuels

- There is recognition that source terms from marine based SMRs and non-water cooled designs need to be addressed

Recommendation

- IAEA to investigate and address this issue in greater detail with priority given to the designs available for near term deployment.
- Country-of-origin of technology to provide technical support

Transportable Nuclear Power Plants (TNPP)

- Guidance needed from IAEA for member states to be able to clarify their own requirements
- Guidance should address any differences between a TNPP and a fuel transport package
- There should be a regulatory discussion on whether the shipment route of a TNPP needs to be part of the site investigations for the power plant site (basis for site acceptance or rejection)

Recommendation



- IAEA to facilitate a regulatory discussion to understand:
 - Similarities and differences between a TNPP and a fuel transport package
 - How the shipment route of a TNPP might need to be integrated into the site investigations for the power plant site (basis for site acceptance or rejection of the site?)
- Based on the discussion, IAEA to consider developing guidance
- Country-of-origin of technology to provide technical support in each instance.

Discussion Point 3



DS-433 and NS-R-3 are, for the most part, suitable as-written for all SMRs.

- Requirements and guidance can be applied in a graded manner
- Some adjustments to guidance may be necessary for designs to be located below ground and Transportable Nuclear Power Plants (including surface and subsurface marine-based)

Recommendation

IAEA to:

- confirm the above conclusion
- examine the NS-R-3 safety guides as a suite against the 3 case studies used (and others if necessary) to address below grade designs, and Transportable Nuclear Power Plant designs (including surface and subsurface marine-based)

Sites in regions lacking in essential infrastructure

- There is greater potential for SMR sites to be located in regions where essential infrastructure to support facility operation or emergency planning is insufficient or does not exist (e.g. off-site power supplies, roads, hospitals, local emergency response capabilities)
- Site surveys and site characterization need to identify the essential infrastructure necessary for safety and security and establish a plan to ensure the infrastructure is in place for when it is needed.
- NS-R-3 currently provides only high level guidance in this area. More detail needs to be documented.
- Guidance is needed on infrastructure considerations for reactor facilities sited in close proximity to hazardous industrial facilities (e.g. emergency plans should be combined/closely coordinated, and to consider coincident events between the two facilities)

Recommendation



IAEA to consider adding information to NS-R-3 and associated safety guides to address SMR sites to be located in regions where essential infrastructure to support facility operation or emergency planning is insufficient or does not exist.

Information should consider both policy-based infrastructure such as national emergency plans as well as physical infrastructure

- “**practical elimination**” will be more challenging for SMRs placed in regions with potential for more aggressive external events or other pressures (near cities or sited in close proximity to industrial facilities)
- **Graded approach** – siting is a risk informed activity with the understanding that it informs the design and the safety case of the facility.

More challenging site conditions means:

- greater impacts on emergency planning – **staffing** implications?
- more pressure on the design to compensate for challenges to operation and **emergency response**

Concepts use in siting that require clarification for public understanding (1)



- Source term (mechanistic source term)
- Core damage frequency (CDF)
- Practical elimination
- Essential infrastructure
- “unacceptable potential effects of the nuclear installations on the region” (NS-R-3 § 2.25)
- Inherently safe
- Passive (safety) features

Concepts use in siting that require clarification for public understanding (1)



- Relationship between emergency planning and the term “inherently safe” - this is an important consideration for both the site survey and site characterization steps.

Recommendation

- IAEA to consider adding this information to DS-433 and NS-R-3 to further clarify guidance