1. Introduction to the URD

1.1. Purpose and scope of the URD

This report is not intended to cover the specific requirements of each and every member country.

- Clarify the user requirements in general (recognizing some users will not have large NPPS these requirements are likely to be similar for large NPPs, particularly of the LWR type e.g. iPWR)
- Focus commentary on how/why user requirements for SMRs may be different from large NPPs.
- Provide some insight into data for requirements
  - This could be specific to a county or region; and
  - may be specific to the user needs
    - user requirements for low cost electricity, desalination, heat, flexibility, spent fuel management may in turn require different technologies with different requirements (e.g. proximity to water, centres of population or industry)
- Expectation that the implications of implementing specific requirements will need to be evaluated (e.g. compliance with a potential for high levels of seismicity is not applicable to all users, short time to deployment may rule out design choice, long operational lifetimes may not be achievable for some technologies that otherwise fit the user requirements.), considering implication on;
  - Ability to meet needs (low cost, desalination, heat, industrial applications (e.g. hydrogen production), flexible supply, spent fuel management)
  - Time to deployment
  - Public perception
  - Ability to finance
  - Ability to regulate (requirements for new R&D and opex)
  - Choice of technology

Work so far;

- info for 1st working group,
- Iran case study;
- 1st draft URdoc

URD Table of contents:

- Nature of energy demand
- Site imposed (site conditions, external events, infrastructure, releases, emergency preparedness etc)
- Licensing (national regs, country of origin, guidelines etc)
- Technical (safety, performance, plant design requirements, constructability, manufacture, maintenance etc)
- Fuel Cycle and Waste Management
- Economics
- Special National Requirements
<table>
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<tr>
<th>User requirements (Table of contents for User Requirements doc)</th>
<th>SMR Specific parameters</th>
<th>Potential impact</th>
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<td>Needs (low cost, desalination, heat, industrial applications (e.g. hydrogen production), flexible supply, spent fuel management)</td>
<td>Time to deployment</td>
<td>Social license</td>
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<td>Ability to finance</td>
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### 1.2. Relation to existing technical documents

Note reference to tecdoc 1167 and 1597– need to check whether this new work adds any new points on the generic issues (i.e. requirements similar to large NPPS) and add in UR’s related specifically to SMR’s?

### 2. National Nuclear Energy Program (specific to the user country)

#### 2.1. User countries energy profile (Energy mix)
2.2. Role of nuclear energy,

2.3. Incentives for SMRs, and what is the specific role of SMRs.

2.4. Additional considerations

2.4.1. Treaties, legal obligations and conventions

2.4.2. National nuclear support infrastructure – (institutional support e.g. regulatory capability, manufacturing, supply chain, manpower, finance – refer to IAEA tecdoc in this area)

3. Site-Imposed Requirements

3.1. Site conditions

- The user can provide site data characteristics to the vendor for site evaluation and design consideration.
- User country expects that the design will not require major modification to meet the requirements of the site characteristics.

3.1.1. Site survey and foundation

- The user country will expect that the basemat and Building foundations meet local site conditions

3.1.2. Atmospheric dispersion characteristics

- There will be a wide range of conditions across countries.
- User will not expect that characteristics effects the design and operational dose.

3.1.3. Thermal discharge limits

There will be an expectation that discharge temperatures (cooling water related) will meet country limits to ensure compliance with environmental regulations.

Other user applications (i.e. other than those that can accommodate deployment of LWR-SMR) may apply and may result in more challenging limits (e.g. no cooling water available).

3.1.4. Hydrological dispersion and hydrogeological aspects

As above

3.1.5. Population and industrial distribution

Expectation that SMRs have the potential be deployed near to center’s of population and industrial centres. This may be a requirement to deploy in some user situations, other situations may be less demanding particularly for FOAK.

3.2. External events
• potential hazards to the plant arising from natural events
• there is a general expectation that SMRs will offer enhanced protection against external events. The user may have a requirement for the plant to be protected in a specific way e.g. underground.

3.2.1. Human Induced Events
• hazards from adjacent industrial installations and transport activities (explosion, etc.),
• aircraft crash etc.

3.2.2. Natural Events
• earthquakes and volcanoes
• external flooding
• extreme meteorological events, such as tornadoes and tropical cyclones, etc,

3.3. Site Infrastructure
• Information of the facilities and services available at the site,

3.3.1. Electricity grid or other energy distribution system connection(s)

3.3.2. Site access by road, water ways and rail
• Expectation that SMRs will be transported with as little modification to infrastructure as possible (many users will require road transport).

3.3.3. Telecommunications
• No change for SMRs. There could be a requirement for remote operation by some users.

3.3.4. Cooling water availability
There is an expectation that SMRs can be readily adapted to dry cooling.

3.3.5. Access to public services such as a fire brigade, medical care, etc.
Some users may not have nearby public emergency services. SMRs may be expected to be to deliver these services.

• Other aspects to consider
• Reduced EPZ
• Seismic tolerance \( \geq 0.3 \text{g} \)?
• Replacement for est. nuclear plants (use existing infrastructure)
• Retrofit for old coal plants
• Remote deployment w/ long fuel cycles
• Smaller footprint / visual impact
• Footprint per MWe comparable to large NPPs
• Transportable by land or rail (for in-land sites)
• Grid compatibility / minimal grid build-out
• Possibility of dry cooling

3.4. Allowable radioactivity release

• Allowable national regulatory limits to release radioactivity gases and liquids for normal operation and incident conditions which are based on the safety design requirements.
• Some users may demand SMRS be deployed under stricter limits (e.g. limits on Boron emission).

3.5. Emergency preparedness

3.5.1. The minimum radius of the emergency control area (e.g. exclusion area boundary (EAB)) within the site

• It uses to control access to the zone including physical barriers and security measures.
• Some countries including Korea, USA employ the concept of having an exclusion zone (E around the reactor for emergency planning (e.g. early evacuation after accident conditions).
• The details of such plans depend on many factors such as type, size and risk considered by the design and by the demographic characteristics surrounding the site.

3.5.2. Requirements for emergency measures at the SMR

• Relates to setting up on site and off site infrastructure to deal with emergency situations.

3.5.3. Emergency planning

• As above

3.6. Allowed Proximity to Urban Area

3.6.1. Darkhovein Site Proximity to Urban Area

• This is recognized as a potential user requirement ie. to be located near to urban centres.

4. Licensing Requirements

4.1. National regulations

• Applicable as per large NPPs

4.2. Licensability in the country of origin
• If a foreign SMR design is introduced, the purchasing country defines the requirements as to the licensability of the proposed design so that the supplier will provide relevant documentation in order to facilitate the user country in licensing activities.
• It is an expectation that SMRs will at least have design certification or have been licensed in the country of origin.

4.3. International guidelines and technical documents. (Optional)
• If the IAEA’s Safety Standards and related technical documents may be used as a basis for formulating national regulations, policies and procedures.

5. Technical Requirements
• User countries can select some of the common requirements for developing their specific technical requirements,

5.1. Safety requirements
  5.1.1. Accident resistance
  • Provisions and features that would be incorporated into the design to ensure adequate margins for assuring: the stability of the core configuration, the capability of controlling neutron power, cooling the core and the confinement of radioactive by-products
  • Design characteristics are required which minimise the occurrence and propagation of initiating events
  • Measures to reduce the likelihood of operator error.
  5.1.2. Accessibility during accidents
  5.1.3. Core damage prevention and mitigation
  5.1.4. Passive safety
  • User preferences may be that passive safety features are implemented in the design.
  5.1.5. Instrumentation and control
  • User preferences
  5.1.6. Radiation protection
  5.1.7. Good neighbor policy
  5.1.8. Protection against physical protection sabotage
  • SMR design should consider physical protection including sabotage for system configuration, plant arrangement and physical protection systems.

5.2. Performance requirements
Performance requirements should specify the expected performance for the intended design performance such as output characteristics, availability/reliability, inspectability and maintainability, design lifetime and manoeuvrability.

5.2.1. Applications

To define the feasible application to uses of a SMR such as electricity production, cogeneration including heat supply for seawater desalination, district heating and industrial heat supply.

5.2.2. Interface

To describe the interface between the SMR and the user country’s energy distribution network and the requirements that must be met to ensure compatibility. (E.g. grid characteristics such as voltage and frequency requirements, range of variability and grid stability)

5.2.3. Availability/reliability

5.2.4. Design lifetime

5.2.5. Ageing management

5.2.6. Maneuverability

To outline the operating modes of the energy distribution system (electricity and/or heat)
- step load changes and power ramps
- load-following capability including frequency (e.g. daily) etc..

5.2.7. Assessment methodology

The methodologies to be used to assess plant performance (e.g. availability)

5.3. Plant design requirements

There will be an expectation that discharge temperatures (cooling water related) will meet country limits to ensure compliance with environmental regulations.

5.3.1. Design approach

5.3.2. Design margins

5.3.3. Human factors and human-machine interface

5.3.4. Standardization

5.3.5. Proven technology

5.3.6. Constructability

5.3.7. Modularization
5.3.8. Capability against load rejection
5.3.9. Reactor Type
5.3.10. Siting
5.3.11. Plant restricted area
5.3.12. Ease of operation and maintenance
5.3.13. Maintainability
5.3.14. Quality management
5.3.15. Decommissioning

6. Fuel Cycle and Waste Management Requirements
6.1. Fuel design
6.2. Fuel supply
6.3. Spent fuel management
6.4. Radioactive waste management
   6.4.1. Storage
   6.4.2. Waste Treatment
   6.4.3. Discharge
   6.4.4. Transfer
   6.4.5. Disposal

7. Economic Requirements
7.1. Criteria and evaluation methodology
7.2. Measures for improved economics
7.3. Financing
   7.3.1. Conventional financing approaches
   7.3.2. Alternative financing approaches

8. Special National Requirements
8.1. Manpower Human Resource Development (HRD)
8.2. Infrastructure and national participation
8.3. Technology transfer
8.4. Licensing Support
8.5. Contractual options and responsibilities
8.6. Extended guarantees and warranties
  8.6.1. Guarantees
  8.6.2. Warranties
  8.6.3. Long term assurance of fuel supply
8.7. Nuclear fuel, special materials and spare parts supply
8.8. Technical support
8.9. Long Term Partnerships