Prospects, Impediments and Expectations from SMRs Design & Technology

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Prospects and Expectations from SMRs

Integral design	• Incorporation of primary system components into single vessel • Elimination of large break LOCA by design • Elimination of Rod Ejection Accident (in case of in-vessel CRDMs) • Improved axial and radial shielding • Increased passivity of decay heat removal
Modular design	• Compact and simplified layout • Fewer structures, systems and components • Lower on-site construction time • Factory fabrication, assembling and testing • Multi-module NPPs offering scalability • Transportable NPPs

Prospects and Expectations from SMRs (Contd..)

Safety aspects	• Elimination of some severe accidents by design • Passive core cooling and residual heat removal systems • Elimination of some failure modes by passivity • Longer grace periods due to inherent safety features • Low core damage frequency (~ 10^{-8}-10^{-10}/year)
Facility size and deployment aspects	• Smaller plant footprint • Smaller EPZ • Reduced plant cooling requirements • Underground placement of containment • Higher Seismic resistance • Moveable or sea based deployment • Deployment in regions lacking essential infrastructure

Prospects and Expectations from SMRs (Contd..)

Flexible applications	• Load following capability enabling cogeneration applications such as desalination, district heating, hydrogen production etc. • Independent power source for energy critical facilities • Suitability for remote regions having small grids • Integration with renewables in hybrid energy systems
Economic aspects	• Lower upfront capital cost • Improved on-site economics • Economy of serial production • Higher learning rate

Challenges in SMRs Development

Demonstration of technology	• ‘Proven’ technology is seen as risk-free option • Demonstration or Prototype SMR NPPs need to be developed • Comprehensive testing and qualification requirements of SMR components and systems
Complex engineering	• Contain to some extent of “first-of-a-kind” engineering systems and components • Updating of codes and standards • Integrated and modular design • Long-term reliability may be a major technological and material challenge • Interfacing with cogeneration and non-electric applications

Challenges in SMRs Development (Contd..)

Economic viability	• Challenges in entering established energy markets • Large initial orders required for securing economy of factory fabrication • Economic competitiveness is not proven yet • Varying estimations of $/kWe values • Demonstration and prototype SMR plants are going through major delays in schedules and cost overruns
Public acceptance	• SMRs deployment and nuclear renaissance is linked with public acceptance • Public advocacy and lobbying are required • Successful public-private partnerships are essential

Challenges in SMRs Development (Contd..)

Licensing & regulatory framework	• Updating of regulatory framework • Legal and institutional framework • Development of pathways to licensing • Lack of human resource with skills and capacity • Long lead-time for regulatory review
Concepts of operation	• Control room's designs for multi-module SMRs • Control room staffing • Design of human-system interfaces • I&C requirements and interfaces

Concluding Remarks

- For successful business plan of SMRs to work, large orders would be necessary
- SMRs are good option to support innovation in nuclear energy technologies and to extend nuclear energy benefits to newcomers
- Regulatory oversight is necessary for maintaining the required level of safety and facilitating effective management of SMR technologies
- Comprehensive work on risk analysis and hazard analysis of systems shared among modules and with cogeneration plants is necessary
- International partnerships would be very beneficial in successful development and deployment of SMRs
- IAEA could materialize the postulated SMRs deployment by actively engaging the developers and potential users and maintaining public advocacy of SMR benefits

Thanks