Non-electric applications of nuclear reactors

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Non-Electrical Applications (NEA)

- Sea-water desalination
- Hydrogen production
- District heating
- Process heat for industrial applications

![Graph showing operating experience in years as of spring 2010]
Prospects for Non-Electric Applications of nuclear Power

• Increased interest of MSs in NEA applications

• Easy to extend current experience with NPPs to NEA

• Market for heat and transportation is huge.

• NEA helps alleviate Environmental concern
Characteristics of the Nuclear Desalination

- Sound technically and economically

- Available experience

- Cogeneration: Nuclear heat and/or electricity
Recent Demonstration Projects

**INDIA:**
- The 6,300 m$^3$/d MSF-RO Hybrid Nuclear Desalination Plant at Kalpakkam, India, consists of 4,500 m$^3$/d MSF plant *(has been commissioned in 2010)* and 1,800 m$^3$/d SWRO plant (operating since 2002).

**Pakistan:**
- MED thermal desalination demonstration plant of capacity up to 4,800 m$^3$/d at KANUPP was also commissioned in 2010.
Challenges to nuclear desalination ND

- Disparity (lack of infrastructural)
- Economics
- Public perception
- Socio-environmental aspects
Nuclear hydrogen

• There is an increased interest in hydrogen as a carbon-free fuel of future.

• Demand for hydrogen is large and keeps growing (at rate of 6-10 % /year).

• Reforming of hard coal and oil (gasification): 96% of current annual hydrogen production
Characteristics of hydrogen production

- Promising
- Still under R&D
- Safety of coupling is still an issue of concern
- Cost of under development processes will be a major factor
Advances on nuclear hydrogen production

• Increase in overall efficiency
• Progress on continuous H2 production,
• Advances in material development,
• Advances in design of heat exchangers,
• Breakthrough on High Temp Steam Electrolysis
Breakthroughs on HTSE

on cells and interconnects

on seals and leaks management systems

Progress on Designs and tests on stacks
NUCLEAR DISTRICT HEATING

• Well proven (Bulgaria, China, Czech Republic, Hungary, Romania, Russia, Slovakia, Sweden, Switzerland and Ukraine)

• Technical features:
  • Heat distribution network
    • Steam or hot water 80-150°C
    • Distribution up to 10-15 km
  • District heat needs:
    • Typically up to 600-1200 MW<sub>th</sub> for large cities
    • Annual load factor < 50%
    • Usually produced in a cogeneration mode
Challenges for Non Electric Applications (NEA) of nuclear Power

- **Safety issues**
  - Coupling of process production plant with NPP

- **Technology**
  - Process system design, control and integration
  - Demonstration of production processes at large scale

- **Economics**
  - Demonstrating production on an industrial scale
  - Building and operating a very large number of NPPs with low energy generation costs

- **Public perception**
IAEA Activities on NEA

Support deployment of demonstration plant(s)

- Establish an info-exchange forum (TMUs, Workshops, CRPs, …)
- Publications (Technical Reports, Journal Papers, Newsletter..)
- Provide tools: DEEP, DE-TOP, HEEP, Toolkit
- Address issues of global concern:
  ➢ Prospects of current nuclear reactors for NEA
  ➢ Prospects for cogeneration (including hybrid technologies)
  ➢ Enhance Viability of NEA
  ➢ Establish close cooperation/collaboration on NEA
Current and future IAEA activities on seawater desalination using nuclear energy

**Underway:**

- **TECDOC document on** technical and economic aspects of feasibility study on using nuclear energy both exclusively for seawater desalination, as well as for cogeneration options (e.g. electricity, seawater desalination, hydrogen production, etc.) **under development**,  
- **DEEP & DE-TOP.** **Just released**  
- **CRP on New technologies for seawater desalination using nuclear energy, ongoing**  
- **TECDOC on Management for Efficient water use and consumption in NPPs, completed and under review.**

- **Int. Conference** on Non-electric applications, 3-6 Oct, Czech Rep. 2011  
- **TM for the TWG-ND, 27-28 April, Vienna**
Current and future IAEA activities on hydrogen production using nuclear energy

Underway:

- **TECDOC document on** Status of hydrogen production using nuclear energy, completed and under review
- **HEEP (released beta version),**
- **toolkit on hydrogen production using nuclear energy (start 2011)**
- **CRP on Benchmarking and validation of HEEP (start 2012)**
- **TECDOC on Advances in nuclear power for process heat applications (Results of the a completed CRP in 2009, completed and final review).**

- **Int. Conference** on Non-electric applications, Czech Rep. 2011
...Thank you for your attention