EXHIBIT 2
DATE 1/31/11
HB 326

Toshiba 4S

From Wikipedia, the free encyclopedia

The **Toshiba 4S (Super Safe, Small and Simple)** is micro nuclear reactor design. It requires only minimal staffing.

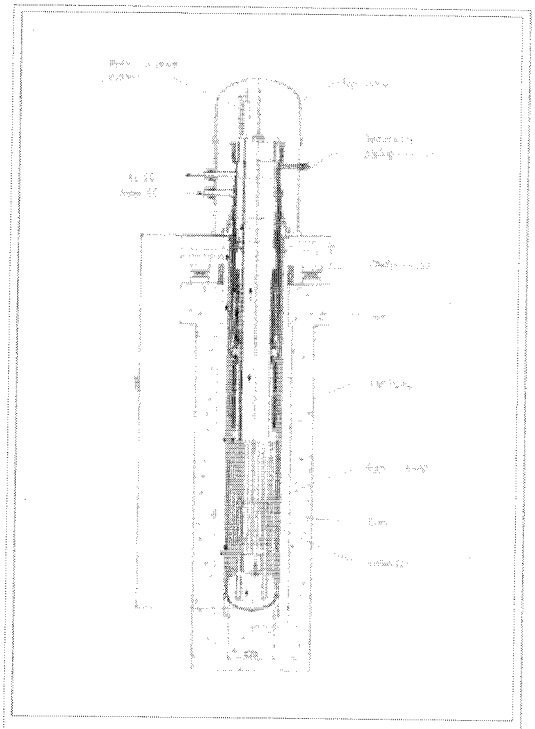
Contents

General description

The plant design is offered by a partnership that includes Toshiba and the Central Research Institute of Electric Power Industry (CRIEPI) of Japan.[1]

The technical specifications of the 4S reactor are unique in the nuclear industry.[2] The actual reactor would be located in a sealed, cylindrical vault 30 m (98 ft) underground, while the building above ground would be 22×16×11 m (72×52.5×36 ft) in size. This power plant is designed to provide 10 megawatts of electrical power with a 50 MW version available in the future.[3]

The 4S is a fast neutron reactor. It uses neutron reflector panels around the perimeter to maintain neutron density. These reflector panels replace complicated control rods, yet keep the ability to shut down the nuclear reaction in case of an emergency. Additionally, the Toshiba 4S utilizes liquid sodium as a coolant, allowing the reactor to operate 200 degrees hotter than if it used water. Although water would easily boil at these temperatures, sodium remains a liquid; the sodium coolant therefore exerts very low pressure on the reactor vessel even at extremely high temperatures.



Vector image of the 4S design

The Toshiba 4S Nuclear Battery is being proposed as the power source for the Galena Nuclear Power Plant in Galena, Alaska.[4] [5]

Current developments

Currently Toshiba, together with its Westinghouse subsidiary, is in the preliminary design review stage of the Design Certification process before the USNRC.[6] Application for certification of the design is currently planned for 2012 when the standardized Design Certification application will be filed for the 4S. The most recent meeting with the NRC took place on August 8, 2008, at which time the NRC's staff met with representatives of Toshiba and Westinghouse for a pre-application presentation of a Phenomena Identification and Ranking Table (PIRT) for the Toshiba 4S (Super-Safe, Small and Simple) reactor. Lawrence Livermore National Laboratory recently released an interesting study on the Toshiba 4S design, which provides an overview of the 4S design and suggests that certain goals may be easier to meet if lead is used as the coolant rather than sodium, due to lead's high transparency to neutrons and low transparency to γ radiation, though lead has a higher melting point than sodium does.[7]

The NRC received the latest version of the letter of intent from the designers of the reactor as of March 13, 2009. The approval process is on track for official submission to the USNRC in October 2010 of a standard application for Design Certification. During the week of October 16, 2009, persons or organizations unknown submitted a Freedom of Information Act request to the USNRC requesting that "documents related to the Super-Safe, Small and Simple (4s) Nuclear Reactor from Toshiba Corporation particularly related to possible placement in Galena, Alaska, including tech info on reactor, safety assessments, nuclear material security, etc." be released to the requestors.[8]

The latest developments at NRC suggest that currently the biggest obstacle facing 4S, or all other small nuclear reactor designs, is not technical nor safety related but rather insurance and legal requirements burdens. Current obligatory insurance and legal compliance is blind to the scale of a reactor placing virtually the same burden on multi gigawatt power plant and small 30 kW installation. NCR is aware of this barrier and has held number of public reviews to devise new scheme that would make it financially feasible to build and operate small reactors while at the same time maintaining appropriate level of protection at large LWR installations.[9] Latest of which took place in December 2010, setting January 2011 as the time frame for preparation of official white paper proposal. [10]

External links

- NRC overview (http://www.nrc.gov/reactors/advanced/4s.html) Official information from Nuclear Regulatory Commission
- Atomic Insights article (http://www.atomicinsights.com/AI_03-20-05.html) information about the reactor, its specifications, and engineering aspects and challenges.
- ROE: Technical details about the 4S planned for Galena, Alaska (http://www.roe.com /about_techGalena.htm) .

See also

- NuScale
- Hyperion nuclear reactor (hydride)
- mPower by Babcock & Wilcox Company
- Traveling wave reactor

References

1. ^ Central Research Institute of Electric Power Industry (http://criepi.denken.or.jp/en/index.html)
2. ^ "Here Come the Japanese Nuclear Reactors" (http://newenergyandfuel.com/http:/newenergyandfuel/com/2009/11/05/here-come-the-japanese-nuclear-reactors/) . http://newenergyandfuel.com/http:/newenergyandfuel/com/2009/11/05/here-come-the-japanese-nuclear-reactors/.
3. ^ "Plans for 'small' reactors nudge waste-disposal concerns to fore" (http://search.japantimes.co.jp/cgi-bin/eo20100503mr.html) . http://search.japantimes.co.jp/cgi-bin/eo20100503mr.html.
4. ^ Toshiba continues efforts for Galena nuclear power plant (http://www.alaskajournal.com/stories/042708/hom_20080427006.shtml) , Alaska Journal of Commerce, April 27, 2008
5. ^ Small Nuclear Reactors Are Becoming Big Business: The race is on to develop refrigerator-size reactors that could power small towns or plants (http://www.businessweek.com/magazine/content/10_22/b4180020375312.htm) , *Business Week*, 2010-05020, accessed 2010-05-24.
6. ^ US NRC Backgrounder on New Nuclear Plant Designs (http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/new-nuc-plant-des-bg.html)
7. ^ Minato, A.; Ueda, N.; Wade, D.; Greenspan, E.; Brown, N. (2005-11-02). "Small Liquid Metal Cooled Reactor Safety Study" (http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=886681) (in Technical English). *Technical Reports*. Livermore, CA, USA: Lawrence Livermore National Laboratory. http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=886681. Retrieved 2010-01-02.
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9. ^ http://www.nrc.gov/reactors/advanced/public-meetings.html
10. ^ http://adamswebsearch2.nrc.gov/idmws/DocContent.dll?library=PU_ADAMS^pbntad01&LogonID=3ce26c19440921aed9c04239cbe10322&id=103500132

External links

- http://www.yritwc.org/Portals/0/PDFs/nuclearreactorletterucs.pdf

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