



PACIFIC NUCLEAR COUNCIL

TASK GROUP ON THE NEXT GENERATION REACTORS

FINAL REPORT TO THE PNC

October 2005

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Final Report to the PNC

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Task Group on Next Generation Reactors

Final Report to the PNC

1. Purpose of Task Group on Next Generation Reactors

To chart the future course for next generation reactors (NGR) and to develop a draft report on recommended cooperative actions for NGR to be considered by the PNC.

2. Activities of Task Group since the Initiation

- Task Group initiated in 1999.
- First PNC Workshop on NGR held in Long Beach (November 1999)
- Second PNC Workshop on NGR held in Tokyo (April 2000)
- Workshop on Advanced and Next Generation Systems (WANGS) held in Honolulu (March 2004)

3. Summary Reports of Workshops and Recommendations to PNC

- Summary of the Workshop and Recommendations to PNC (November 1999)
- Summary of the Workshop and Recommendations to PNC (April 2000)
- Report of the Workshop on Advanced and Next Generation Systems (WANGS) (March 2004)
- Position Statement on The Next Generation of Deployment and Research on Nuclear Energy, and Enhanced Cooperation among Pacific Neighbors (November 2004)
- This final report (Drafted and discussed at the PNC Meeting in May 2005)

4. Report of present NGR activities and near-term position

Since the Task Group formed, there have been several key developments that have influenced its activities. Therefore, the Task Group has endeavored:

- To keep up with the latest international activities under GIF and INPRO related to NGR (Gen IV) as they affect PNC members.
- To encourage a more broadly based dialog at PBNC meetings about NGR, including near term deployment plans for NGR deployment in Pacific Basin countries.
- To chart a course of involvement and updating of all the developments underway.
- To attempt to bridge the gap between countries with existing nuclear nations and those who aspire to deploy nuclear energy programs.
- To reflect the growing importance of the Pacific region in commercial nuclear deployment as a result of economic growth.
- To increase the attendance of countries active or interested in next generation reactors at PBNC meetings and also encourage a wider participation in next generation reactors information exchange at PNC meetings by way of specialist sessions and workshops.

The reality is that the PNC Task Group is an interested observer and not a party in any way to the GIF and INPRO developments. The Task Group hence can provide a forum for dialog and exchange for a broader Pacific Basin audience, and encourage cooperation between PNC member countries and with non-members also. In addition, the role of PNC efforts is shaped by the increasing number of (competing) technical meetings on NGR, that may directly affect many PNC members. Moreover, the NGR

Workshops have proved to be popular and highly regarded by those who attended. They provide a level of detail beyond those of PBNC Plenary sessions and focus more on promoting cooperation and exchanges related to integrated strategies and NGR concepts, not on specific R&D results.

Hence the NGR Task Group has a valuable function of providing a non-partisan, non-country, non-threatening specific forum for such dialog, including those aspects relevant to rapidly developing economies. The NGR Task Group can naturally take an important role in exchanges related to:

- Providing a forum for a continuing overview of nuclear development policies and plans in the Pacific Region;
- Establishing and exchanging ideas on NGR options and development status among PNC members and interested non-members;
- Reviewing implications for national and PNC and non-PNC members' nuclear energy strategies;
- Seeking areas of common development, and establish goals for NGR cooperation and information exchange;
- Facilitate establishing additional interfaces between NGR and Gen IV developers, and PNC member suppliers, researchers, planners and policy makers;
- Providing a 'neutral ground' for dialogs on NGR development directions.

5. Completion of the Task Group Activities and Suggestions for Future Activities

- As the Task Group on Next Generation Reactors has accomplished its initial mission and has fulfilled the role, it is concluding this phase of its activities. The Task Group leaves records of reports, conclusions and recommendations of past workshops in the PNC's archive, and issues the Position Statement as the final recommendation.
- When this Task Group was initiated and the first Workshop was held, such international activities on advanced and next generation nuclear systems as the 'Generation IV Nuclear Energy Systems International Forum' and the 'International Project on Innovative Nuclear Reactors and Fuel Cycles' were not yet started. Now, these two activities are placed in orbits, well established and PNC should support and yet utilize these activities via the mechanisms previously discussed, targeted specifically at Pacific Nuclear Council member countries and other related prospective member countries and non-member countries in the PNC working region.
- As possible follow-up activities of PNC in relation to the advanced and next generation nuclear systems, the following three Task Group activities may be suggested:
 - To set out a vision and develop a roadmap on recommended cooperative actions in the Pacific Region regarding the next generation nuclear systems including the fuel cycles and reactor systems for electricity/hydrogen/water supply. This will include such subjects as regional fuel cycle centers, transportation of nuclear fuels, future nuclear electricity/hydrogen/water supply complexes, nuclear based energy supply architecture and so on. These subjects will soon become important, particularly in the Asia Pacific Region where expected nuclear energy growth is large and should match with the non-proliferation regime and advanced technology supports.
 - To continue to facilitate Workshop-type activities, in conjunction with PBNC meetings where possible, with the objectives of

furthering exchange, knowledge and strategies for NGRs in the Pacific Region.

- To develop specific enhanced actions and cooperation on advanced nuclear systems (Generation III+ and Gen IV) in the Pacific Region.

Notes: These activities will focus on subjects outside the present scopes of GIF and INPRO. These activities should be performed in the category of new PNC Working/Task groups that have a time limit to conclude.

This report was approved at the PNC meeting of October 9, 2005, Tsukuba, Japan.

Attachments

1. Pacific Nuclear Council's Workshop on Next Generation Reactors

November 13, 1999, Long Beach, CA, USA

This summary presented by Co-Chairs Masao Hori and Robert Vijuk during the November 14, 1999 Pacific Nuclear Council meeting, Long Beach, CA, USA

Development of a program for meaningful future cooperation and action by:

- Identifying issues on next generation reactors development in this region
- Developing solutions using regional cooperation
- Recommending future activities to the Pacific Nuclear Council

Overview of Next Generation Reactors Development in Each Country/Region:

Chair: Masao Hori

- US: Madeline Feltus, DOE/Carl Walter, Nuclear Engineer Emeritus
- Canada: Jerry Hopwood, AECL
- Korea: Young Sang Choi, KEPRI-KEPCo
- Japan: Yoshiaki Oka, U. Of Tokyo

Twenty minutes for presentation and short Q/A for each country/region

Items Discussed:

Concerning the development of next generation reactors in the Pacific Region, the following items are to be discussed:

- Necessity of Next Generation Reactors Development in the Pacific Region
- Issues on Next Generation Reactors Development in the Pacific Region
- Necessity and Role of Cooperation on Next Generation Reactors Development in the Pacific Region
- Conceivable Field of Cooperation on Next Generation Reactors Development in the Pacific Region
- Scheme of Cooperation on Next Generation Reactors Development in the Pacific Region

Discussion Highlights.

NGR Development is Necessary

Issues:

- Must Be Economic
- Must be publically acceptable
- Size Differences To Be Rationalized
- International Licensing To Be Rationalized
- Siting Issues
- Resources
- First Unit Challenges

Roles for Cooperation:

- Manpower
- Funds
- R&D Facilities
- Stabilize project
- Licensing Standards and confirmatory research
- Fuel Cycle
- Reduce project risk
- Technology Transfer

Fields for Cooperation

- See “Roles for Cooperation,” above
- Supercritical Coolant
- High Temperature Materials
- Passive Approaches and Analysis Tools
- Risk Assessment Models

Schemes of Cooperation – Roles

- Government to Government
- Company to Company
- IAEA/NEA/OECD
- Institute to Institute
- Non-Government Organizations (Country Nuclear Societies, PNC, INSC)
- Non-Nuclear Organizations (Environmental, Renewables, ETC.)
- Academies of Sciences
- Universities
- Scholarships
- All or Combinations of Above

Recommendations

- Follow Up Workshop
In About One Year, to include Non-Nuclear participants
- Report on Recommended Cooperative Actions
In About One Year

2. The Second Workshop on Next Generation Reactors.

Tokyo, Japan April 24, 2000

SUMMARY

At the 2nd PNC Workshop on Next Generation Reactors, the participants have reviewed and discussed the following subjects with due consideration to the sustainability, safety assurance, nonproliferation characteristics and marketability, of these future nuclear energy technologies:

- Viable reactor options such as plants based on Light Water Reactors, Heavy Water Reactors, Gas Cooled Reactors, Liquid Metal Reactors and Accelerator Driven Systems.
- Viable frameworks for cooperation such as new mechanisms based on ecology, financing and energy demand, and new architecture based on nonproliferation regimes.

Varieties of nuclear plants based on the reactors under study or development were discussed with due emphasis on such important requisites for future global supply of energy as follows;

- Sustainability
 - Fuel resources
 - Environmental impacts (including waste)
- Safety Assurance
 - Design
 - Operation
- Nonproliferation Characteristics
 - Technological
 - Institutional/international
- Marketability
 - Economic competitiveness
 - Scale
 - Financing
 - Service for front and back end fuel cycle
- Need for development and timing of deployment

For the Pacific region, where both developed countries and developing countries exist, deployment of the next generation reactors for energy supply could involve both the technical development of reactor plants and the provision of institutional/international frameworks for cooperation.

It is desirable that commercial or market mechanisms will prevail in future deployment of energy systems, but there are several issues, such as nonproliferation, safety, environment, financing assurance, which could be facilitated by way of institutional/international frameworks for cooperation.

- One example is potential application of the Clean Development Mechanism, which was discussed at the COP-3, to deployment of advanced nuclear plants. Such application could be beneficial both for a developed country (emission right) and for a developing country (financial support).
- As the front-end and back-end fuel cycle issues need to be addressed when future nuclear power plants are deployed, concepts based on use of a regional (multinational) fuel cycle center could be beneficial because it could resolve issues associated with proliferation.
- To assure the safety of nuclear energy in all countries that operate nuclear

plants, regional cooperation or partnership may be considered in addition to formal international measures.

At this Workshop, some of the important concepts on these institutional issues were presented. Also, constraints of developing countries and role of cooperation were discussed.

The Workshop participants concluded;

- There will be an emerging market in the Pacific region for nuclear energy as a clean, economic and sustainable energy source.
- Next generation reactors (NGR) with advanced design should be developed for a timely introduction to the market, which meet various requisites for energy supply in this region in the future.
- Synergistic approaches with cooperative interaction among such possible measures as technological development, commercial venture, institutional measures and multinational projects/organization may be important.
- A task group will be formed to develop a draft report on recommended cooperative actions for NGR development to be considered by the PNC.
- Member organizations from countries with on-going NGR development programs are requested to nominate participants for the cooperative action report task group.
- Cooperative actions should consider opportunities between developed countries and developing countries as well as themselves, indeed among all the countries of the region.
- A third NGR Workshop will be held to review the cooperative action draft report. The PNC should consider
 - issuing a statement on the potential for nuclear energy, including fuel cycle options, to meet future world energy needs;
 - issuing a statement to support the eligibility of nuclear power prospects under the Clean Development Mechanism;
 - issuing a statement to the World Bank requesting support for future nuclear power projects;
 - establishing and promulgating positions on fuel supply and regional spent fuel management; and
 - establishing a position on providing nuclear power "capability" assistance to developing countries within the region.

3. Workshop on Advanced and Next Generation Systems

Honolulu, USA (March 24, 2004)

SUMMARY

This PNC task group recently conducted a Workshop on Advanced and Next Generation Systems (WANGS). It was the third in a series of workshops the PNC conducted on this topic. On behalf of task group co-chairs Jerry Hopwood and Masao Hori, task group member Romney Duffey chaired this special workshop event.

As discussed at the PNC meeting of March 21, 2004, the workshop was an opportunity to exchange information on the current status and future of next generation reactors. It will bring this issue to an interim conclusion for the Pacific Basin via the preparation and distribution of a report currently in preparation by the Task Group.

Participating in the workshop were representatives of eight Pacific Basin countries, and all of these countries participate in the PNC through their respective Council member organization(s). From the presentations and estimates made at the workshop, it appears that Pacific Rim countries will most likely be pursuing several new advanced reactor technology options for both the near term and the longer term. The detailed options described for advanced and next generation systems and the development/deployment timing for these options generally reflect Generation IV Roadmap descriptions.

The reactor types for the near term (2005–2020) are Generation III+ evolutionary designs of existing reactor types. Any advanced concept (e.g., Generation IV) is seen as following that time frame, consistent with the present long-term technology development time frames and programs.

Among the workshop conclusions were:

- Advanced and Next Generation Systems are expected to be relatively cheaper, safer, and environmentally friendly, and also are expected to provide superior performance and operation.
- From the presentations and estimates made at the Workshop, the Pacific Rim countries will likely be pursuing a build scenario such that the Pacific Rim will be the host to approximately 20 new constructions over the next 5 years (2005–2010), and as many as approximately 40 for the next interval 2010–2025. This number is a major growth, and shows the importance of the region in the nuclear future.
- The initial advanced systems expected are the so-called Generation III+ -- evolutions of and advances from today's designs for short-term deployment from about 2005 to 2020. Much more development is required for so-called Generation IV concepts, for deployment subsequent to 2020.
- Now is the appropriate time for enhanced actions and cooperation, given the needs for global security of energy supply, lower energy costs, regional economic growth, and the emergence of global environmental issues that require regional solutions, technical innovation, and political resolved.
- The Task Group will develop a PNC Position paper on *"The Next Generation of Deployment and Research on Nuclear Energy, and Enhanced Cooperation among Pacific Neighbors."*