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International Atomic Energy Agency
Atoms for Peace and Development

Industrial Involvement Major elements: (4) Capacity Building & Incentives (5) National Investment

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Major Element (4)

Capacity Building & Incentives

Elements for successful Industrial involvement

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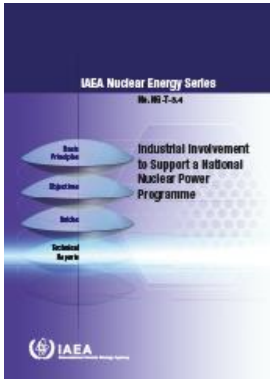
Receiving countries need to develop/prepare/conduct;

- Capacity surveys of local industries
- Policies for developing industrial capacity
- Industrial standards & quality assurance mechanisms
- Capacity building activities such as:
  - ✓ National R&D programme
  - ✓ Partnership w/ competent players for <u>Technology Transfer</u>
  - ✓ Long-term and low-interest loan for capital investment
- National/Local investment for the above activities
- Negotiation with vendor and/or EPC contractor

Technology Transfer (TT) as an efficient way of capacity building

- TT is defined as "the process of moving technology from one entity to another."

- Both assets & knowledge are covered.



IAEA Nuclear Energy Series No. NG-T-3.4 (2016)

- Intellectual Property Rights should be protected under specific laws.
  1) Industrial Property (e.g. patent, design, trademark)
  2) Copyright (e.g. literary, scientific work, software)

TT excerpts from the Milestones Framework

Basis for Evaluation in the "Industrial Involvement" issue

Phase 1:

A policy for national involvement in the nuclear power programme has been developed, taking into account current industrial capacity and technical services, current and required quality standards, and potential investment requirements. The policy may include short-term and longer-term targets for industrial involvement.

Phase 2:

A review of national capability has been completed, identifying areas where national supply is available or can be developed. Based on this, volume targets, or specific areas, for national involvement have been developed. Plans for upgrading national capability have been defined and funded. The transfer of technology including intellectual property has been considered.

Source: Evaluation of the Status of National Nuclear Infrastructure Development IAEA Nuclear Energy Series No. NG-T-3.2 (Rev. 1) (2016)

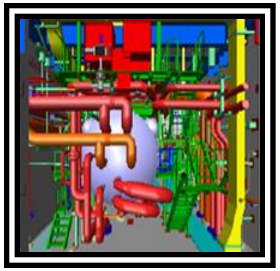
Why is TT Significant?

- Vendors' Viewpoints:
  - Reinforce Long-term Relationship with Receiving Countries
  - Make Offers & Contracts more competitive
  - Cultivate New Market in Nuclear & Other Industries

- Receiving Countries' Viewpoints:
  - Acquire Intellectual Property & Know-how more efficiently
  - Improve Standards of Technological Education & Training
  - Develop Capability transferred to Other Industries through "Spin-offs"

Types of TT: Techs can be Transferred

1) Design Tech



- From the R&D stage to the Final Process Design of all the systems comprising NPP.

2) Manufacturing & Construction Tech

- From Design of Equipment to Special Manufacturing Techs & Quality Assurance in the NPP construction.

3) Project Engineering & Management

- Works for the successful execution of the NPP project including Office & On-site Activities.

Stages of TT: Moving toward Self-reliance

1) Initiating Stage
   - Technical dependency as a subcontractor
2) Selective Stage
   - Technical acquisition of the technology as a subcontractor
3) Adaptive Stage
   - Joint design of indigenous products (start modifying the vendor's tech to adapt to specific markets) as a subcontractor or primary contractor
4) Mastery Stage
   - Technical self-reliance as a primary contractor

Structures of TT: Defining the Scope & Nature

1) Inter-governmental Agreements

➢ Give a framework of TT. Detailed agreements can be among R&D, Standard or Educational Institutions if both parties wish.

2) Company Agreements

➢ Give a definition of "which" and "how" techs are to be transferred. Basically they forms four types of structure:

1. Licensing Agreements
2. Technical Cooperation Agreements
3. Joint Ventures
4. Consultancies

A Case of TT in Another Industry: Airbus China

- Mainly targeted for "Manufacturing & Construction" technologies, as in the "Selective" to "Adaptive" stages.

- Under the "Company Agreement," facilities in China cover activities such as the assembly of aircraft, cabin installation, painting, delivery.

- Operations as a "Joint Venture" of Airbus & Chinese consortium, supported by local government.

Source: Airbus "Airbus in China"
http://www.aircraft.airbus.com/company/worldwide-presence/airbus-in-china/

A Case of Technology Transfer: Hitachi and GE

1945 Defeat in WWII: 60-70% of production capacity damaged

1949 "Foreign Exchange & Trade Act" enabled tech-partnership

1952 Hitachi negotiated with potential partners in gas turbine:
1) AEG@German, 2) EE@UK, 3) GE@US

1953 Hitachi decided GE (= gave up doing by herself) and proposed policies (subsidies & tax merit for investment)

1966 Hitachi and GE agreed tech-partnership in nuclear power
⇒ System License: 1) design documents & analysis tools,
2) dispatched engineering staff to GE San Jose site

1974 "Shimane Unit.2" localized in 94% mainly by Hitachi

Lessons Learned from this case

- It's good strategy to build multiple channels to negotiate, even in an early phase for Technology Transfer.

- Technical partnership(s) can be developed in each stage as progress of capacity building (or might be phased-out).

- It's important that industrial sector makes policy proposals to the gov proactively. Utility & industry know their needs.

- Technology Transfer is not only for overall NPP(s), but also for varied types of tech such as component design & manufacturing, software engineering, construction, etc.

Major Element (5)

National Investment

Elements for successful Industrial involvement

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Receiving countries need to develop/prepare/conduct;

- ❑ Capacity surveys of local industries
- ❑ Policies for developing industrial capacity
- ❑ Industrial standards & quality assurance mechanisms
- ❑ Capacity building activities such as:
  - ✓ National R&D programme
  - ✓ Partnership w/ competent players for technology transfer
  - ✓ Long-term and low-interest loan for capital investment
- ❑ National/Local investment for the above activities
- ❑ Negotiation with vendor and/or EPC contractor

Key factors in National Investment

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- Policies MUST be implemented. It impacts all of stakeholders in nuclear & other sectors.

- The government roles are:

1) to decide whether a NPP program is a viable option.

2) to persuade stakeholders why the government should invest in a NPP program and other related areas.

3) to discuss priorities regarding job creation, foreign exchange demand, scheduling, or others of NPP projects.

4) to evaluate whether the investment (e.g. directly through subsidies, indirectly through tariffs or import control) will lead to stronger companies in high-skilled field.

Ref. Industrial Involvement Policies to be developed based on the result of Pre-F/S (typically in phase 1-2)

- Objective: Enhance local capabilities efficiently in NPP(s).
- A set of policy tools may involve
  - ✓ **National Plan** to introduce the NPP(s) in long-term
  - ✓ **Policy Goal** (e.g. localization rate, technical achievement)
  - ✓ **Subsidies** for R&D, capital investment, HRD, etc
  - ✓ **Tax Merit** for capital investment, import of equipment, etc
  - ✓ **Government Finance** (e.g. low-interest & long-term loan)
- Policy resource can be from outside (e.g. export credit from vendor countries, grant from intl' organizations)
- There is no silver bullet; depends on country, time, or market.

National Plan is the basement for all stakeholders

- National Plan (authorized by the gov) affects behavior of stakeholders such as local industries, TSO, intl’ vendors.
- National Plan usually involves 1) goal (status to be achieved), 2) specific actions of each stakeholder, 3) a set of policies.
- The plan should cover long-term, but can be flexibly revised.

A Case of National Investment: 1950-60s, Japan (1)

- Long-term National Plan was authorized in 1956 – at first focusing on electric supply, rather than industrial localization.
- Research Reactors supported local industries to catch up NPP technologies. Main contractors were from the US, while sub-contractors such as fabrication & installation were mostly Japanese companies. (ref. JPDR's localization rate: 55%)

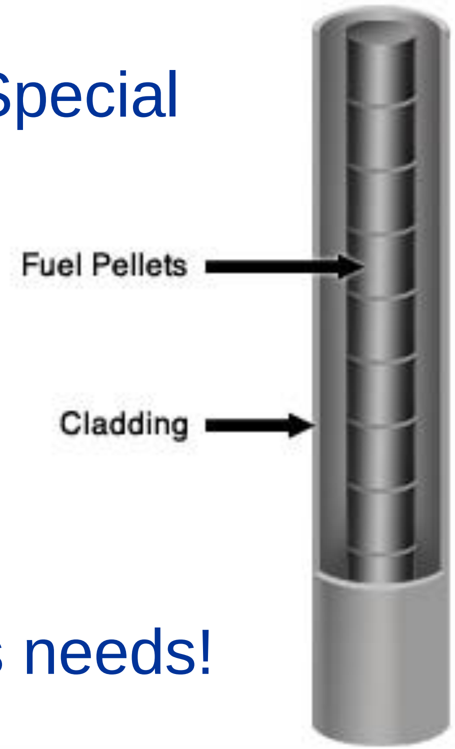
JRR-1 or Japan Research Reactor No.1
(operated for 1957-1970)

JPDR or Japan Power Demonstration Reactor
(operated for 1963-1976)

A Case of National Investment: 1950-60s, Japan (2)

- Long-term & Low-interest Loan for "NPP localization activity" was established by National Development Bank in 1966.
- Subsidy for R&D in manufacturing (e.g. welding technology for fuel cladding, special processing treatment for RPV)
- Tax Benefit such as Exemption from Tariff, Special Depreciation.
- Local industry association had officially proposed policy ideas on industrial involvement to the gov in 1950-60s.

  ⇒ The gov knows policy, but industry knows needs!



Lessons Learned from the case of national investment

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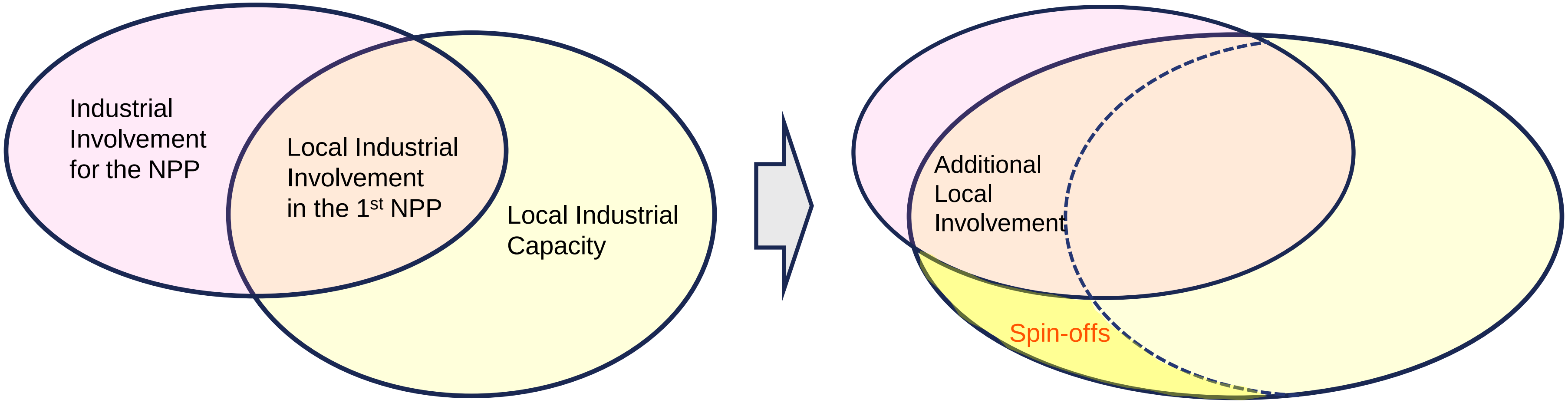
- The government should lead the national plan, but it can be revised flexibly as changes of circumstances.
- Research Reactor can be a strong "enabler" for building supply-chain and opportunities for Technology Transfer.
- The # of stakeholders increases as progress, while policy resources are limited. ⇒ Avoid bureaucratic sectionalism…!
- Therefore, it needs a venue of discussion among different stakeholders such as industries, utilities, government officials.
- Policy resources can sometimes depend on outside (ref. Japanese industries relied on international makers-credits, export credit finance from a vendor country in 1950-60s).

As appendix: “Spin-offs”

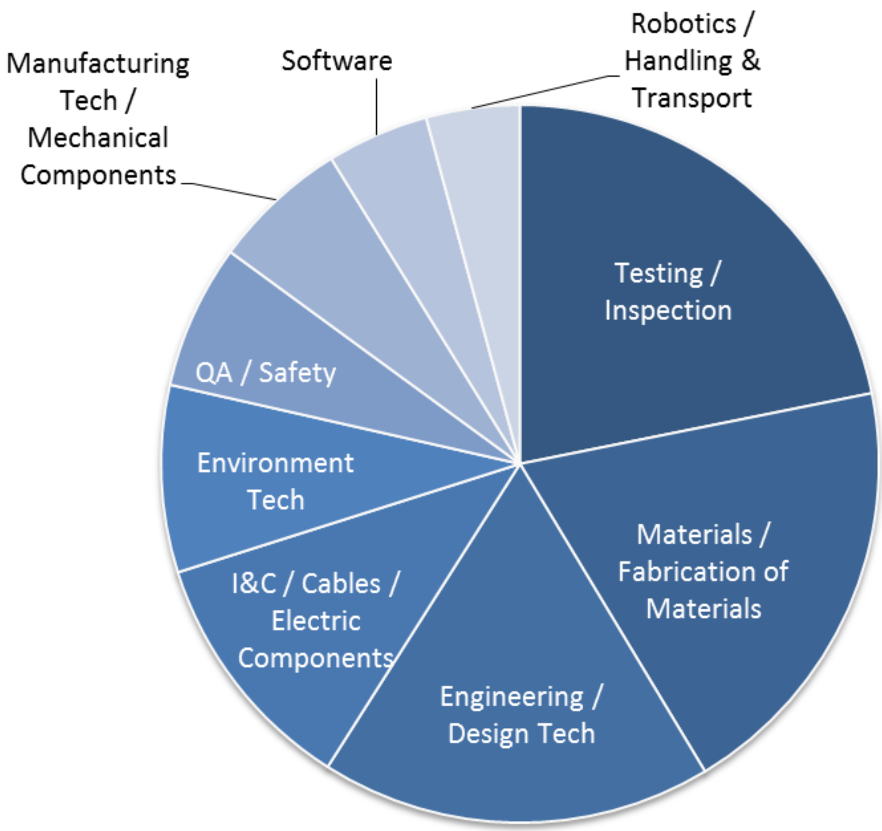
"Spin-offs" borne by the NPP Projects

- "Local Industrial Involvement" can expand as NPPs mature.
- This expansion will depend on several factors such as Government Policies, the # of NPP, and TT Agreements.
- There can be "Spin-offs" through participation in the NPP.

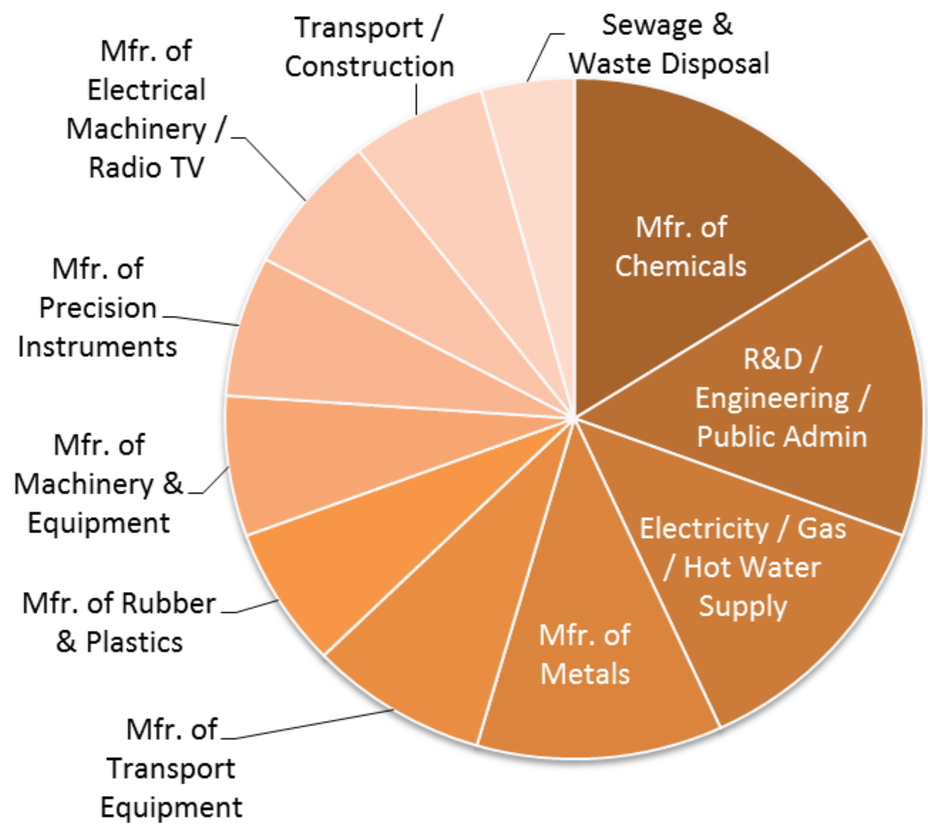


"Spin-offs": Technology and Target Industry

Category of Technology (n = 261)



Target Industry (n = 255)

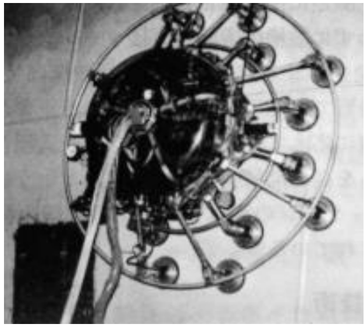


Ref. OECD/NEA "Spin-off Technologies Developed Through Nuclear Activities" (1993)

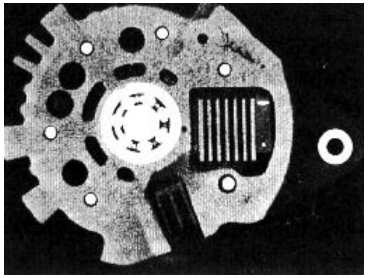
* Only items represented by more than 10 cases noted in this chart.

Examples of Techs applied to Other Industries

- **Seismic Response Technology**: can be used in base isolated foundations for buildings
- **Remote Controlled Inspection Technology**: can be used in the maintenance of ships
- **Non-destructive Inspection Technology** (e.g. X-ray, Acoustic and Associated Imaging): can be used in non-nuclear plants
- **Laser Technology** (e.g. For Improving Residual Stress): can be used in automobile, aviation and other manufacturers



Inspection Robot for Spherical Gas Holder

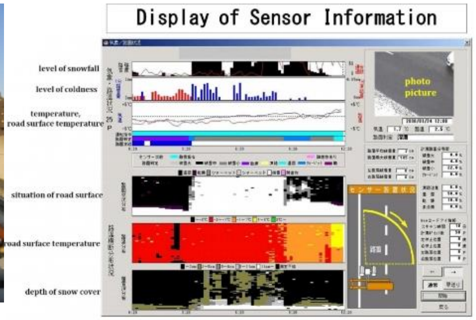


Imaging by X-Ray Computed Tomography

Source: Oka, Y. et al, "Application of Nuclear Power Technology to Other Industry" (1997)

A Case of Spin-offs: RR to a Small Company

- A road surface sensor improved its accuracy of snow determination by anomaly detection technology in a nuclear Research Reactor.
- An owner of the reactor (national R&D organization) allowed a small company (manufacturer of sensor) to use the patent.
- It was a case under the government policy to encourage "Spin-offs" from nuclear to non-nuclear industry.



Source: Yamada Giken
http://www.yamada-giken.co.jp/index.php?gid=912&kiji_id=65

Tips for Successful “Spin-offs”

- Spin-offs are basically occasional. The ways of generation range from “spontaneous” to “organized”.
- Spin-offs themselves are not unique to the nuclear industry: it can be insightful to look through “better practices” from other industries and/or other countries.
- Spin-offs policies should consider basic issues such as:
  - Understanding the target industry sector and the way it works.
  - Carefully assessing technical, economic or market applicability.
  - The field of application needs to be defined as tightly as possible.

Terima kasih banyak!

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