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Human Resource Development of Nuclear Engineering

- Education in Japanese Universities -

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Outline

- Historical development of nuclear engineering education in Japanese universities
- The scope of nuclear engineering education at Tokyo Institute of Technology
- Examples of activities; Statistics of
 Employment of master students
 The number of students from abroad

Historical development of Nuclear Education in Universities:

1953 Address of “**Atoms for peace**” by Eisenhower

1955 Enactment of

“**Atomic Energy Fundamental Law**” in Japan

Establishment of

Nuclear Engineering Courses in Graduate Schools

1957 Opening of graduate courses of

nuclear engineering in three universities

Kyoto Univ., Osaka Univ., Tokyo Institute of Tech.

2007 Fifty years anniversary of these graduate courses

Expansion of Education Programs for "Nuclear Energy" in Undergraduate Schools

1958 **Kyoto Univ.**, "Department of Nuclear Engineering"

1960 **Univ. of Tokyo**,
"Department of Nuclear Energy Engineering"

1962 **Tohoku Univ.**, and **Osaka Univ.**,

1966 **Nagoya Univ.**

1967 **Hokkaido Univ.** and **Kyushu Univ.**

Graduate courses were established 4 years after the opening of undergraduate courses in Univ. Tokyo, Nagoya Univ., Hokkaido Univ. and Kyushu Univ.

Nuclear Education in National Universities



1980's ~ 1990's Nuclear Education in Japan

Accidents of nuclear power plants generated the "wind against nuclear".

Fusion program was promoted:

Plasma research facilities were built in Nagoya, Tsukuba, Kyushu universities

In other universities, including Tokyo Tech., research activities of nuclear engineering were maintained in the field of "fusion".

"Fusion" was an attractive topic for students.

Fusion Science and Technology saved nuclear education in universities

Nuclear Education at risk , 1990 ~ 2005

The decreasing number of

- nuclear education programs,**
- students applying for the nuclear engineering,**
- young professionals in nuclear engineering,**
- employment by nuclear industries.**

Imbalance between graduated students and employment

- Master course students ~ 300 person / y**
- Employment by nuclear industries ~ 70 person / y**

Department of Nuclear Engineering, Tokyo Institute of Technology

- **Establishment : 1957**
- **Educational staffs: Research laboratory for Nuclear Reactors**
- **Admission of students:**

**20 ~ 30/year in Master
~ 10/year in Doctor**

Oversea students 5 ~ 10 /year

**The grand total of graduated Master students:
~1000**

Educational Activities of Nuclear Engineering

- **Master program (2 years)**
Course work (30 credits) + Research work
- **Doctor program (3 years)**
Research work
- **Integrated Doctor program (4 years)**
Compulsory international internship
- **International program for students from abroad**
Scholarship of Japanese Government
- **Educational cooperation with outside agencies**
JAERI, CRIEPI, NUMO
- **COE(Center of Excellence Program)**
- **Remote education system among Tokyo Tech.**
Fukui and Kanazawa Universities.

Curriculum of Nuclear Engineering (Master)

Core Nuclear Engineering

Nuclear Reactor Theory
Nuclear Reaction and Radiation
Nuclear Chemistry
Nuclear Thermal Engineering
Nuclear Fuels and Materials
Fuel Cycle Engineering
Nuclear System Engineering
Nuclear Reactor Designing
Nuclear Safety Engineering
Nuclear Back-end Engineering
Radioactive Material Transport
Nuclear Engineering Experiments

Extended Nuclear Science

Plasma Engineering
Fusion Reactor Technology
Computational Phys. and Eng.
Quantum Beam Engineering
Medical Application of Rad.
Medical Accelerators
Adv. Course of Combustion
Nano-Material Science.
Environm. Energy System
Modern Society and Technol.

**Internship (domestic),
International Internship**

Where do the students go after Master ?
Employment of Master Students, 2004 - 2006
: Nuclear & and Heavy Industries

Electric Power Company

Tokyo, Hokkaido, Shikoku, JAPCO

Nuclear Manufacturing Co

Toshiba, Hitachi, Mitsubishi H.

Fuels and Service

Fuel Transport, Atox, Tepco Systems

Steel and Heavy Industries

Nippon Steel Corp. JFE Steel, Kobe Steel

Public Agencies

JNES, PNC(JAEA), METI

Employment of Master Students, 2004 - 2006 : Non-Nuclear Companies and Agencies

- **Toyota, Suzuki, Honda, Komatsu**
- **Sharp, Panasonic, Seiko-Epson, Citizen
Casio, Toyo Techn.**
- **JSR, Showa-Shell, Nichirei,**
- **JR-Hokkaido, JR-Kyushu, JR-Fleight**
- **NHK**
- **JST**

Employment of Students after Master Program (past 5 years)

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Employment of Students after Master Program (1988 - 2006)

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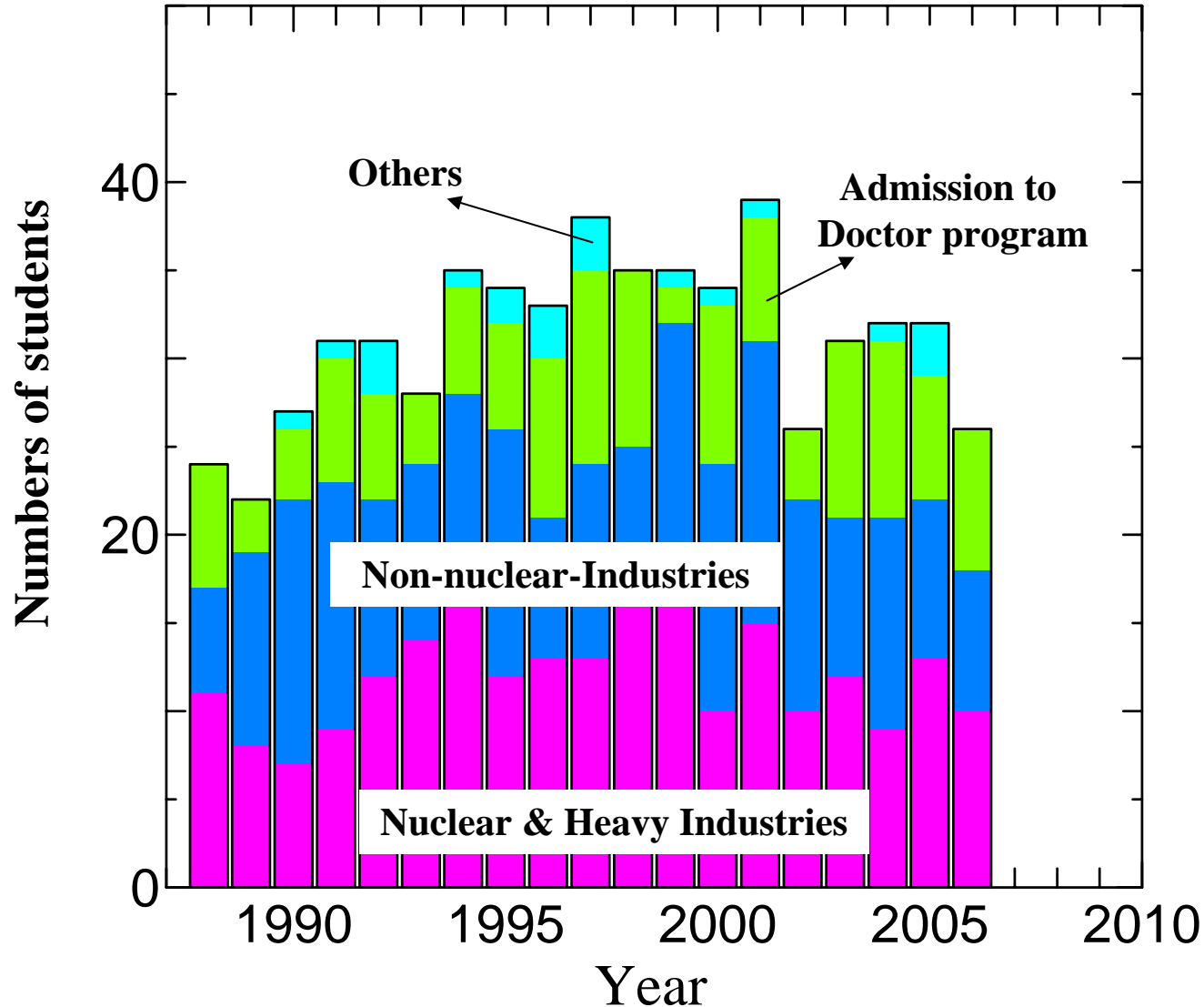
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Employment of students after graduation from the master program of nuclear engineering (1988-2006)



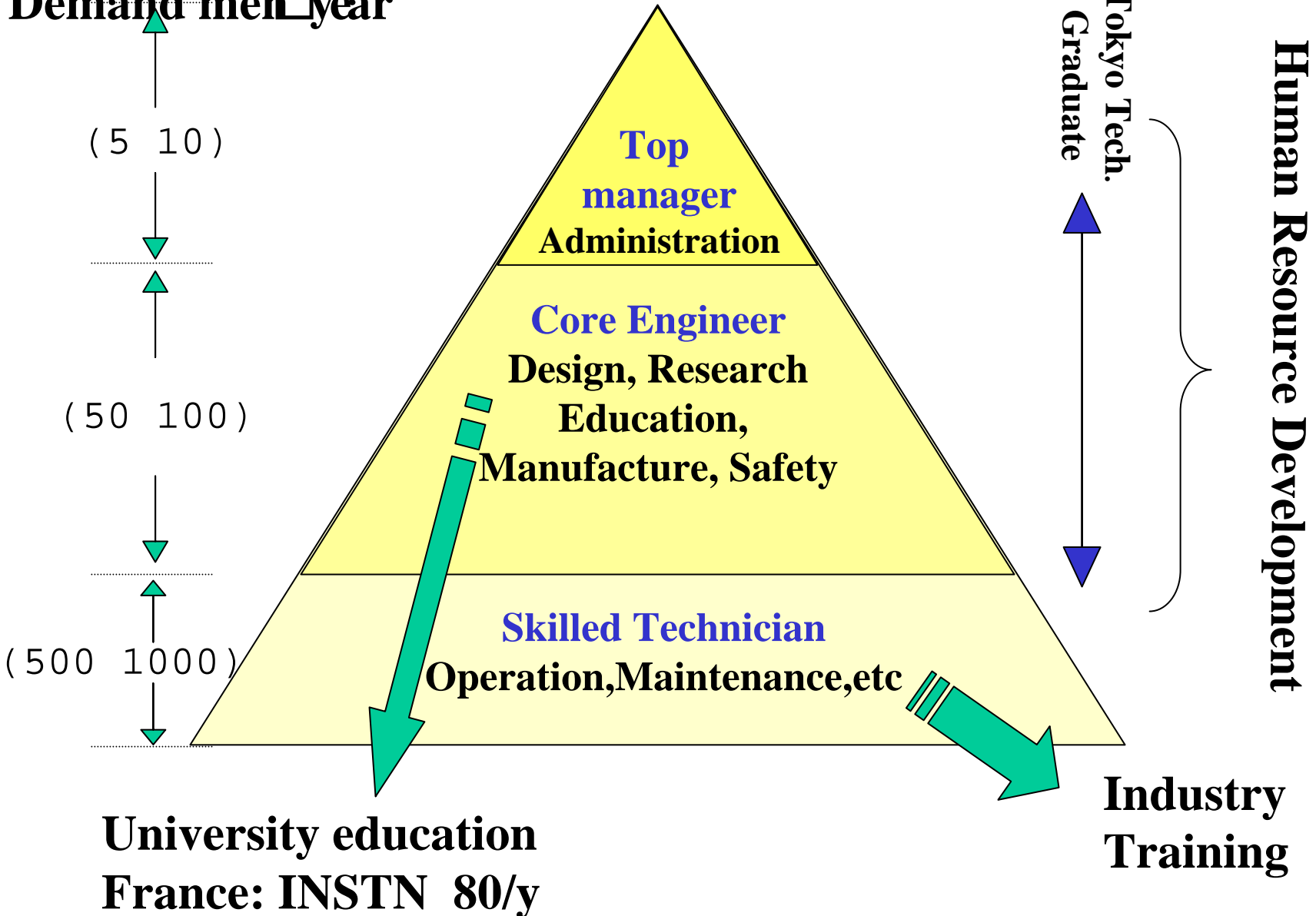
Education for Foreign Students (1995 – 2007)

Country	Master	Doctor	M+D
Indonesia	10	16	26
China	6	11	17
Russia	4	10	14
Korea	4	5	9
Bangladesh	1	3	4
Kazakhstan	2	2	4
Vietnam	2	1	3
Thailand	0	3	3
Ukraine	1	1	2
Germany	0	2	2

Country	M	D
Egypt		1
Hungary		1
Italy		1
Turkey	1	
Malaysia	1	
Lithuania	1	
Total	33	57
Grand Total	90	
Av.	7 / y	

Role of University Education

Nuclear industry
Demand men/year



Conclusion

- Tokyo Tech Graduate School has continued a full scope education of nuclear engineering for past five decades since 1957.
- It should be noted, Tokyo Tech maintained the nuclear engineering education for past 20 years under the serious “wind against nuclear”.
- The number of students graduated from Master Program of Nuclear Engineering Department amounts to 1000.
- Average 10 master students every year get their jobs in nuclear industries.
- International Course was established in 1994 and totally 90 students have graduated from the master and doctor programs.

Nuclear Energy Education in the 21st Century

Nuclear energy should be **a common energy**, supported by the public and industries.

Technology development should be made by the collaboration between industries, research institute and **universities**.

Education should be also conducted by the initiative and **collaboration of educational sectors, industries, and communities** with the support of the Government.

Thank you for your attention !

Lessons learned

Nuclear Energy was developed by Government and Big Companies !

The public did not participate in the development.

This may be a big problem in the case of Japanese Nuclear Development.

National Universities in Japan

Enhancement of Graduate Schools ~ 1990's ~

Graduate schools of selected major universities were expanded and strengthened by the policy of Ministry of Education.

However **nuclear engineering courses were diluted and their names of courses were changed** to more broadened terms like "**Quantum**", "**energy**" and "**System**" in several universities.

Change to University Corporation 2004