Social Cost Assessment for Nuclear Fuel Cycle Options in the Republic of Korea

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Abstract

World energy consumption is constantly increasing in response to population growth and greater individual demands for energy consumption. Before deciding which energy supply systems to rely on for base line power, we have to assess the economics of each power supply system individually. This research will investigate the vast array of economic factors to estimate the true cost of the nuclear power. Previously the approach to evaluating the external cost of nuclear power did not include various fuel cycle options and influencing parameters. Cost has always been a very important factor in decision-making, in particular for policy choices evaluating the alternative energy sources and electricity generation technologies. Assessment of external costs in support of decision-making should reflect timely consideration of important country specific policy objective. In the Republic of Korea, five different scenarios of nuclear fuel cycle were analyzed to address the country's spent fuel management challenges. Thereby resulting in cost assessments that not only compare traditionally evaluated nuclear fuel cycle scenarios, but are expanded to include energy options that are on the horizon of ROK's nuclear energy program. This evaluation will not focus only on "cost" but will address all the factors associated with cost.

● Background

Existing Cost parameters of nuclear power

Construction	Operation and Maintenance	Fuel
Financial cost from net construction expense, Cost of purchasing a site, Cost of material and equipment, Service fee of design technique, Special support funds of local community in a new site, Total cost from construction process	Operation cost of nuclear power plant except fuel cost, Maintenance cost of nuclear power plant except fuel cost, Labor costs including consumables and equipment cost, External support services, Cost of coolant and moderator supplement, Insurance of nuclear accidents, Support funds of local community in a new site , R&D funding, Total cost from managing the nuclear power plant and radioactive waste	Purchased cost of fuel

Objectives

To suggest a trans-scientific cost assessment of nuclear fuel cycle in the ROK for political decision making process determined by external influences, conditions, and specific social environment

- Trans-scientific nuclear fuel cycle is based not only technology but political, social, and scientific issues.
- The nuclear fuel cycle options will be selected from the decision-making process based on this research.
- The cost parameters currently considered by adding new areas and expanding on the types of situations considered will be broaden.

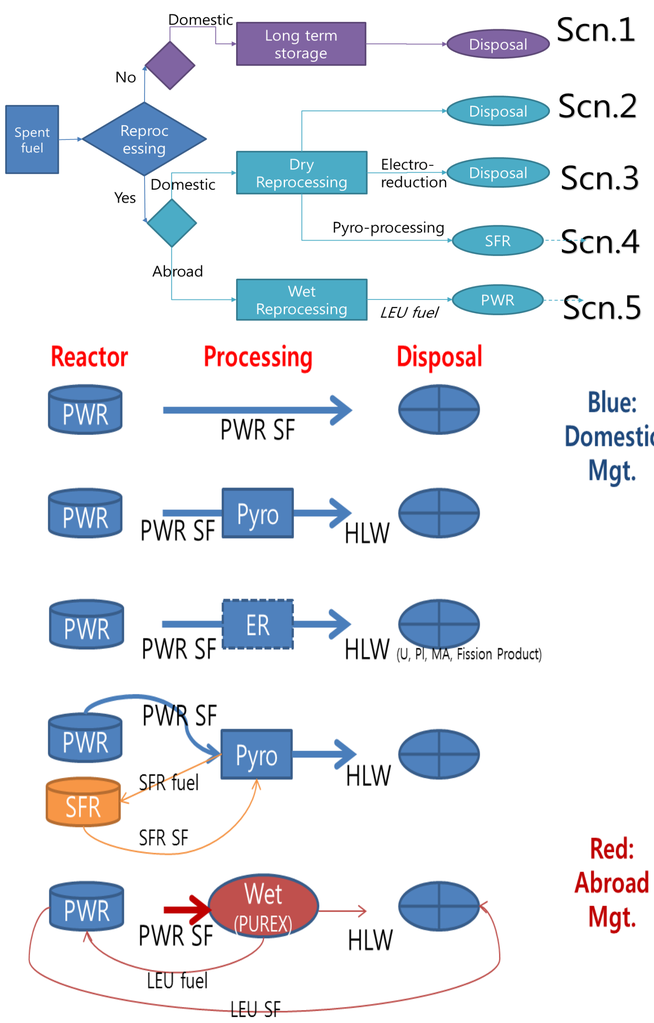
Key tasks

To identify nuclear fuel cycle scenarios

To broaden the scope of the parameters

To develop a method for the external cost for each fuel cycle scenarios

● Selection of Nuclear Fuel Cycle Scenarios



S1. OT

A once-through cycle

S2. OT-Pyro

Direct disposal of high level waste after pyro-processing of spent fuel

S3. OT-ER

Direct disposal of high level waste after electrolytic reduction of spent fuel without the separation of nuclear materials

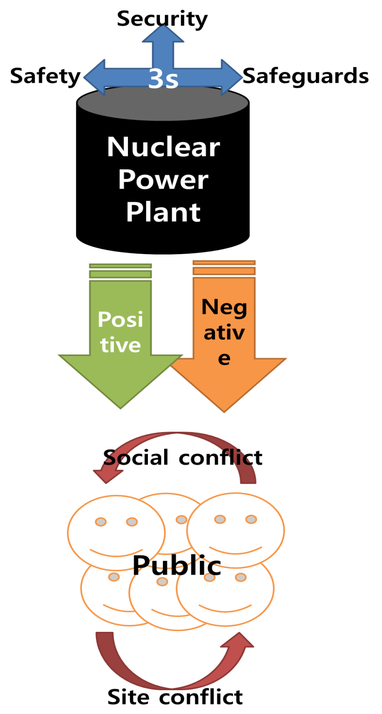
S4. SFR-Pyro

Recycling of nuclear materials in fast reactor after pyro-processing of spent fuel

S5. PWR-LEU

Thermal recycling using LEU fuel in a PWR

● List of Social Cost Assessment Parameters



Big class	Middle class	Subclass
A. Impacts on society	1.Negative effect	Health effect
		Risk aversion
	2.Positive effect	Energy security
		Climate security
B. Impacts of public	3.Site conflict	Site area
	4.Social conflict	Social cohesion
		Social stability
		Social equity
C. Impacts on 3s	5.Security	Nuclear material
		terrorism
	6.Safety	Nuclear accident
	7.Safeguards	Proliferation resistance

● Results

Evaluation criteria	OT	OT-Pyro	OT-ER	SFR-Pyro	PWR-LEU	Unit
U utilization efficiency	0.84	0.84	0.84	1.54	0.84	%
Amount of Waste	2.213192	2.201738	0.0017	0.151748	0.0023	tHM/TWh
Health effect	1	29.5	0.23	29.8	0	*
Risk aversion	Unknown					
Energy security	12	12	12	19	13	month
Climate security	Unknown					
Site area	2.079	0.143	2.068	0.309	0.346	Won/kWh
Social conflict	Unknown					
Security	Unknown					
Nuclear accident	0.1	0.1	0.1	0.075	0.1	Won/kWh
Proliferation resistance	0.537 (H)	0.501 (H)	0.503 (H)	0.523 (H)	-	-

*Ratio of total cumulative dose to humans per fully loaded HLW repository to the OT cycle case

PWR-LEU and SFR-Pyro are the best fuel cycle in parameter of environment impacts, but OT or OT-ER is proper than SFR-Pyro in case of public sight. Using the OT fuel cycle is better than SFR-Pyro to reduce the site conflict cost. When energy supply is deficient, SFR-Pyro fuel cycle stands longer than other fuel cycles. Proliferation resistance is shown as 'high' in all fuel cycles, so there are no difference between fuel cycles. When the severe accident occurs, SFR-Pyro cycle is economical than other OT based fuel cycles.

● Future work

Social conflict (Social cohesion, Social stability, Social equity) will be used the social cohesion index (SCI), and Security (nuclear terrorism, nuclear material protection) will be used the the Nuclear Threat Initiative (NTI) Nuclear Materials Security Index. It can be analyzed the relationship between NTI and public acceptance of nuclear power. Then, the fuel cycle assessment can be performed by assigning a weight to each parameter and using multi-criteria decision-making (MCDM) methods.