Silesian University of Technology

RESEARCH UNIVERSITY EXCELLENCE INITIATIVE
Ministry of Science and Higher Education

QUANTITATIVE ANALYSIS OF RADIOACTIVE WASTE PROBLEM RELATED TO THE POLISH NUCLEAR ENERGY PROGRAM

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Outline of the presentation

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1. Introduction

Polish Nuclear Energy Program (potential locations of nuclear power plants)

Big reactor NPP

6… 9 GWe

in big NPPs

(3x2 reactors

or 2x3 reactors)

>20 SMRs

SMR NPP

Sources: www.gov.pl, Orlen Group

2. Aim and scope of work

Evaluation of potential spent nuclear fuel inventory.

- Calculations for big scale reactor systems based on chosen technologies (AP1000 and APR-1400)
- Calculations for SMR based systems (BWRX-300)

Base for computations: data provided by producers of selected reactors.

3. Big reactors

Technical specification (selected data)

Parameter	Unit	AP1000	APR-1400
Thermal power	MW	3400	3983
Gross electric power	MW	1200	1455
Net electric power	MW	1100	1400
Lifetime	years	60	60
Availability	%	93	90
Fuel mass in the core	kg UO_2	95 975	103 300
Refuelling period	months	18	18

3. Big reactors

The fuel campaign of PWR reactors is carried out in a zonal irradiation system.

Typically, 1/3 of the fuel is discharged from the core in each cycle and replaced with fresh fuel assemblies, having previously moved the fuel used but remaining in the core for the next cycle towards the center of the core. This is how the fuel campaign is carried out in the case of the AP-1400 reactor .

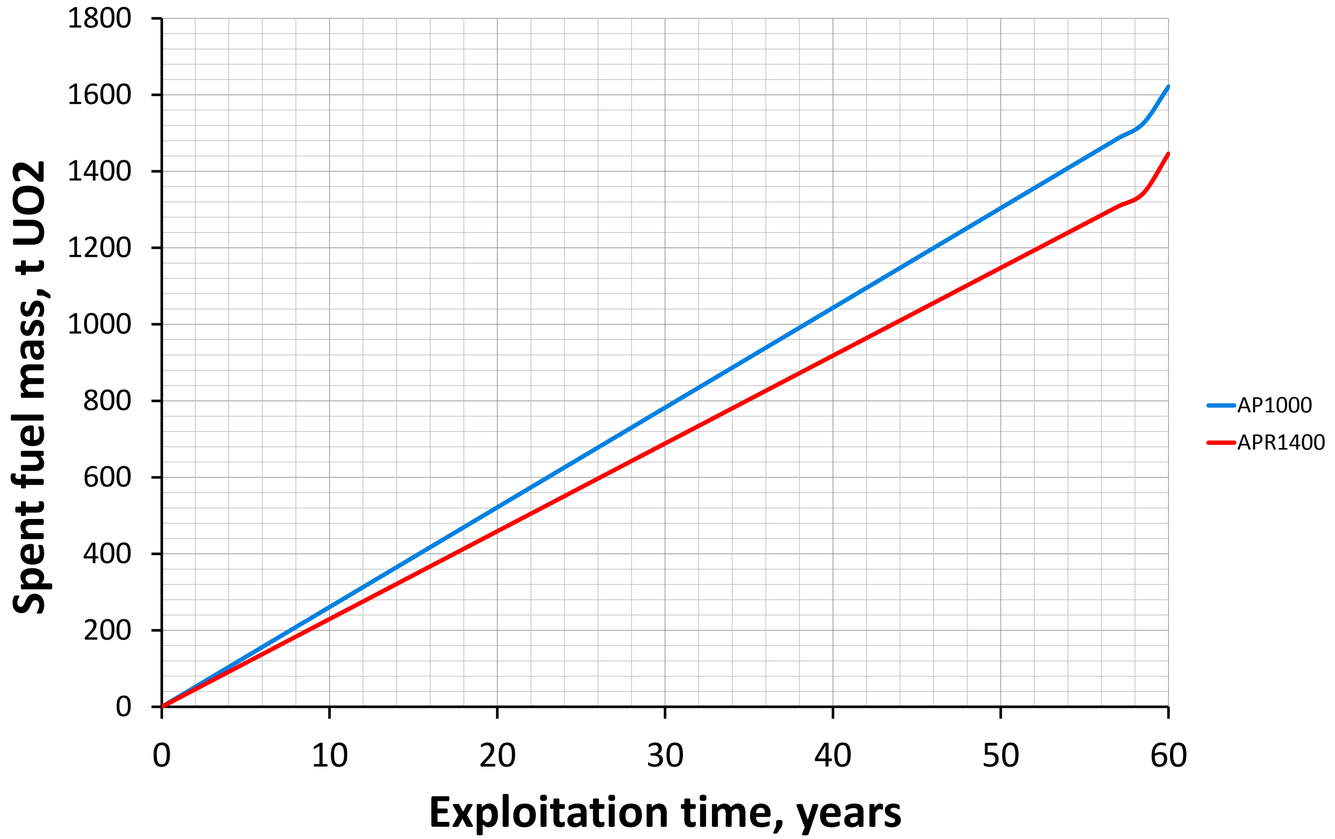
The AP1000 reactor core consists of 157 fuel assemblies, and document [A] states that 64 assemblies are replaced during reloading.

[A] Westinghouse AP1000 Design Control Document, revision 19.

Published 21.06.2011 (available at https://www.nrc.gov/docs/ML0715/ML071580895.pdf).

3. Big reactors

Spent fuel mass for single reactor



3. Big reactors

Spent fuel mass for option:

2 x AP1000 + 2 x APR-1400 + 2 x AP1000	8254 t HM (for 7200 MWe net installed power)
3 x AP1000 + 3 x APR-1400	8100 t HM (for 7500 MWe net installed power)
3 x AP1000 + 2 x APR-1400	6827 t HM (for 6100 MWe net installed power)

4. Small Modular Reactors

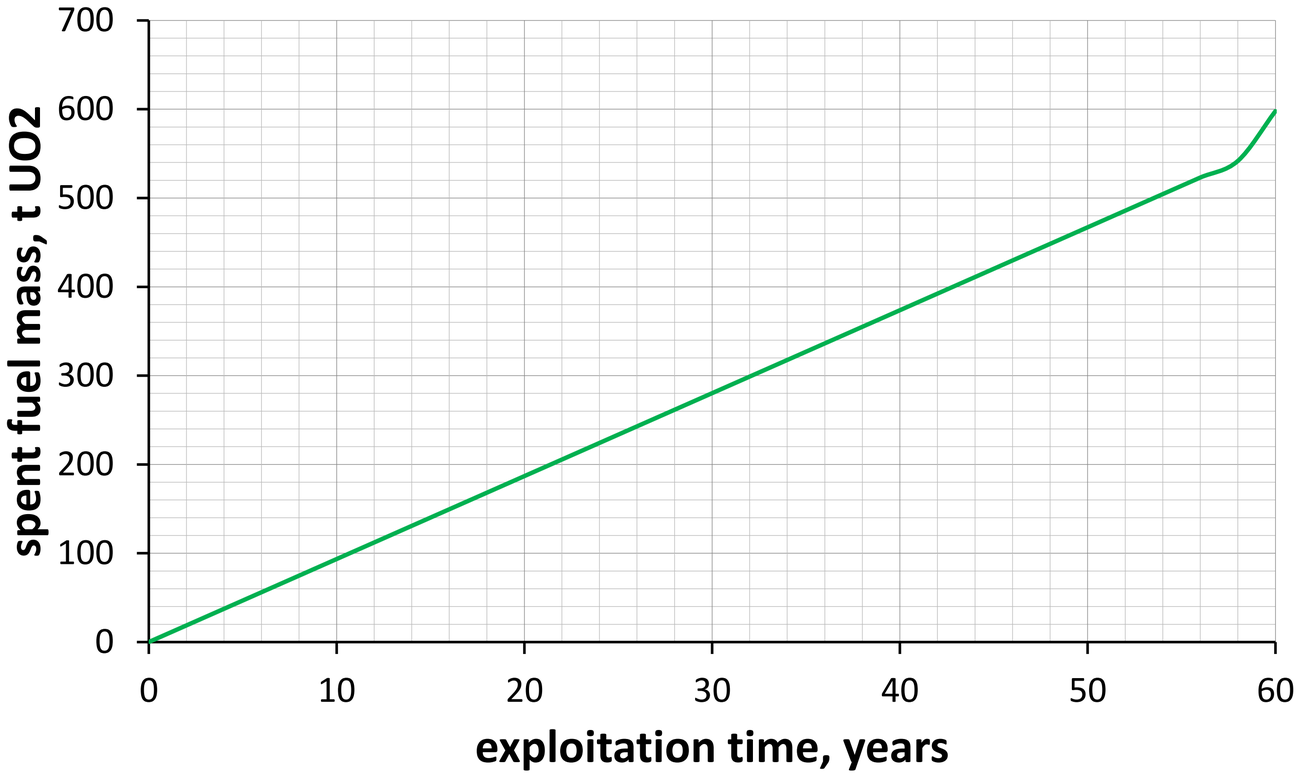
Technical specification (selected data)

Parameter	Unit	BWRX-300
Thermal power	MW	870
Gross electric power	MW	300
Net electric power	MW	290
Lifetime	years	60
Availability	%	95
Fuel mass in the core	kg UO_2	56 038*
Refuelling period	months	24

* Value estimated according to ARIS data

4. Small Modular Reactors

Spent fuel mass for single BWRX-300 reactor



4. Small Modular Reactors

Spent fuel mass for a fleet of BWRX-300 reactors:

1) Single reactor in each location: 7 x BWRX-300 — 4179 t HM
2) 20 BWRX-300 reactors (according to the last annoucement) — 11 940 t HM
3) 10 BWRX-300 reactors (according to previous declaration) — 5970 t HM

5. Conclusions

Knowledge of the potential amount of spent nuclear fuel and other types of radioactive waste is crucial for proper planning of the management of these materials. This applies to the methods and routes of transport between individual points of the fuel cycle (e.g. nuclear power plant, spent fuel reprocessing plant, final repository) as well as the structure and capacity of the final repository for these materials.

The obtained results allow, to some extent, to evaluate selected technological solutions, but it should be emphasized once again that these results are estimated. At the same time, these results show a strong sensitivity to the adopted input data and assumptions, which increases the level of uncertainty of such an assessment. Nevertheless, the results obtained here confirm the earlier estimates made for the "National plan for the management of radioactive waste and spent nuclear fuel".

THANK YOU FOR YOUR ATTENTION

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