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D. Salazar, F. Franceschini, P. Ferroni
Westinghouse Electric Company LLC

B. Petrovic
Georgia Institute of Technology

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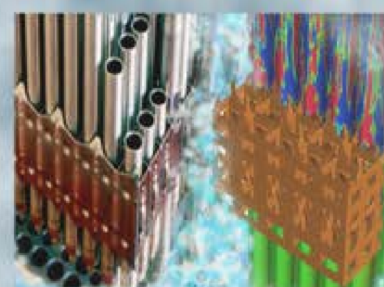

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D. Salazar, F. Franceschini, P. Ferroni
Westinghouse Electric Company LLC
Cranberry Township, Pennsylvania, USA
SalazaDA@westinghouse.com; FranceF@westinghouse.com; FerronP@Westinghouse.com

B. Petrovic
Nuclear and Radiological Engineering, Georgia Tech, Atlanta, Georgia, USA
Bojan.Petrovic@gatech.edu

ABSTRACT

This paper presents the fuel management options developed for the Integral Inherently Safe LWR (I^2S-LWR). The I^2S-LWR is a reactor concept of a ~1,000 MWe (2,850 MWt) integral PWR with inherent safety features. The baseline core configuration contains 121 fuel assemblies with a 19×19 square lattice and 144-in active fuel height. The baseline fuel choice is U_3Si_2 in advanced FeCrAl-type steel cladding, which is envisioned to enhance accident tolerance but is detrimental to neutron economy. SiC cladding is also under consideration as it can foster further improvements in accident tolerance with excellent neutron economy. Standard UO_2/Zr fuel is under investigation as an option for accelerated deployment. The performance of these three fuels, U_3Si_2/FeCrAl, U_3Si_2/SiC and UO_2/Zr, is examined and compared in this paper; the focus is on fuel management and fuel cycle cost aspects for the I^2S-LWR core at the equilibrium cycle with an 18-mo cycle length.

Key Words: I^2S-LWR, high power density core, silicide fuel, equilibrium cycle

1 INTRODUCTION

This paper discusses the core design options under investigation for the Integral Inherently Safe Light Water Reactor (I^2S-LWR)[1]. The I^2S-LWR is an innovative Pressurized Water Reactor (PWR) in the pre-conceptual design stage. The research work is led by the Georgia Institute of Technology, with a design team that includes several US and international universities (U. of Michigan, Virginia Tech, U. of Tennessee, U. of Idaho, U. of Florida, Morehouse College, U. of Cambridge, Politecnico di Milano, U. of Zagreb, Brigham Young University), Idaho National Laboratory, Westinghouse Electric Company and Southern Nuclear Operating Company. The I^2S-LWR is envisioned to further enhance safety through the adoption of several features, the most important of which are the integral configuration, a fully passive decay heat removal system to provide indefinite cooling capability for a class of accidents, and use of new fuel materials, i.e., U_3Si_2 pellet within FeCrAl steel cladding or SiC cladding. The fuel management and fuel cost at the equilibrium cycle of the I^2S-LWR with U_3Si_2 fuel and either FeCrAl or SiC cladding are presented here. The comparison with the standard UO_2 fuel and Zr-based cladding (ZIRLO® has been assumed) is also given.

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1 CORE AND FUEL DESIGN

1.1 Fuel Assembly Design

The baseline core and assembly configurations selected for the I^{2}S-LWR are depicted in Figure 1. The core contains 121 assemblies with 144-in active fuel height, same as current Westinghouse 2-loop PWRs. However, the I^{2}S-LWR aims at achieving approximately 40% higher power rating than a 2-loop core (2850 MWt vs. ~2000 MWt). To support this objective, the fuel assembly has been modified from the 14×14 or 16×16 typical of 2-loop cores to a 19×19 square pitch lattice with approximately the same footprint, and with the main geometric parameters and fuel design characteristics shown in Table 1. The increased number of fuel rods in the 19×19 lattice counterbalances the higher power density in the I^{2}S-LWR thereby benefitting DNB performance and, also thanks to the high thermal conductivity of U_3Si_2, fuel temperature. The larger number of fuel rods in the 19×19 lattice leads to approximately same average linear power, 5.8 kW/ft, and only about 3% higher heat flux at the rod surface, 62 kW/ft^2, for the I^{2}S-LWR relative to a 5% uprated 4-loop PWR with 17×17 lattice. The I^{2}S-LWR also features a stainless-steel type radial reflector which reduces neutron leakage and improves neutron economy, with the added benefit of reducing the fast neutron fluence on the reactor vessel

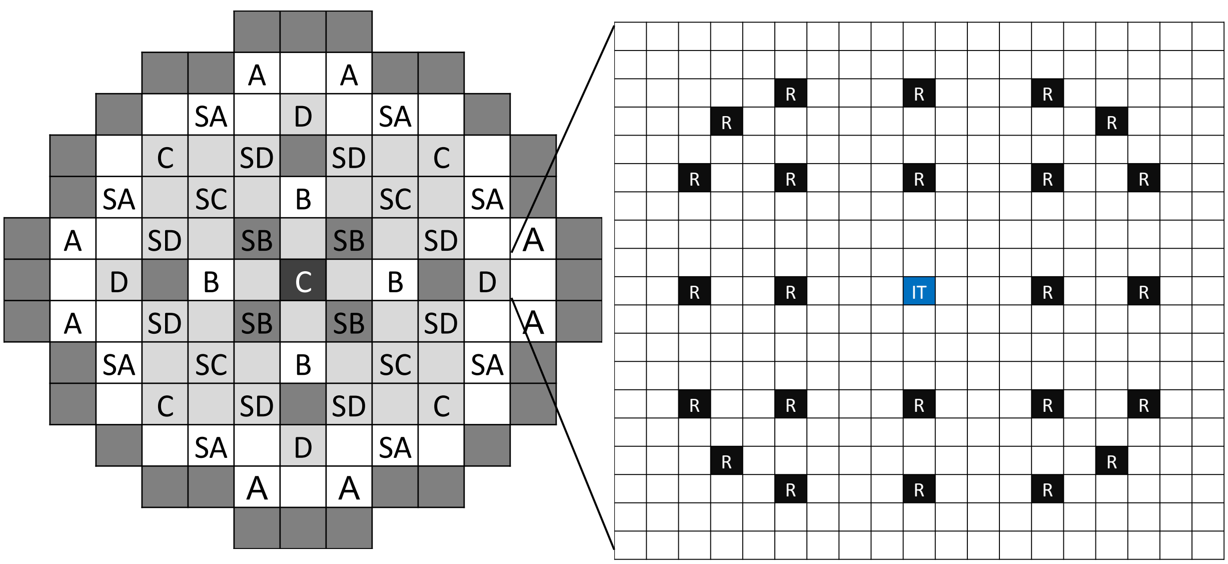

Figure 1 I^{2}S-LWR core layout (left) and fuel lattice design (right)

The I^{2}S-LWR features 45 reactivity control cluster assemblies (RCCA) with 24 control rodlets per RCCA. The control rod bank core configuration is shown in Figure 1together with the location of the 24 control rodlets within the assembly. The guide thimble and control rod dimensions are given in Table 1. Shut-down margin analysis has confirmed that the control rod design and RCCA configuration chosen are adequate for all fuel types being investigated for the I^{2}S-LWR.

Table 1 I^{2}S-LWR Fuel Lattice Characteristics

Configuration	19x19 Square
Fuel rods per assembly	336
Assembly pitch (in)	9.095
Fuel rod pitch (in)	0.477
Fuel rod OD (in)	0.360
Guide Thimble ID/OD (in)	0.406/0.435
Control rodlet clad OD/ID (in)	0.350/0.316
Control rodlet poison OD (in)	0.313
Control rod pellet material	Ag-In-Cd

Table 2 I^{2}S-LWR Fuel Design Options

Pellet **Cladding**	**U_3Si_2** **FeCrAl**	**UO_2** **Zr**	**U_3Si_2** **SiC**
Cladding thickness (mils)	16	22.5	30
Pellet-clad gap width (mils)	3.1	3.1	3.5
Pellet OD (in)	0.3218	0.3088	0.2930
Area Gap (% of Inner Clad Area)	3.7	3.9	4.6
Fuel density (% of theoretical density)	95.5	95.5	95.5
Core Heavy Metal (MT)	81.7	64.1	67.6
H/U (at. ratio)	3.11	3.95	3.75

1.2 Fuel Rod Design

U_3Si_2 is envisaged as the primary fuel option due to the higher heavy metal (HM) density and thermal conductivity relative to UO_2 [2][3]. The higher HM density, a 17% increase compared to UO_2, is beneficial since it facilitates implementing more efficient fuel management strategies. The better thermal conductivity leads to fuel temperatures that are significantly lower than UO_2-fueled cores, and to a weaker dependence of fuel temperature on linear power variations, which both enhance operational performance and safety.

An irradiation campaign in the Advanced Test Reactor at Idaho National Laboratory is ongoing, with the purpose of gaining a better understanding of U_3Si_2 fuel behavior, including irradiation-induced swelling. For this study, an U_3Si_2 swelling rate similar to that of UO_2 has been assumed, and the pellet-clad gap has been dimensioned accordingly. The gap values of each case analyzed are shown in Table 2 together with the other key fuel rod design parameters.

Advanced FeCrAl steel cladding and grids are proposed for the I^{2}S-LWR, as opposed to current Zr-based materials. This choice is driven primarily by enhancing accident tolerance through deployment of a robust cladding material that can withstand high temperature (>1200°C) steam-water conditions without experiencing the high oxidation and hydrogen generation rates of Zr-based alloys. Recent investigations performed at Oak Ridge National Laboratory [4]-[7] have shown that, by tailoring the steel composition, an alumina or chromia protective oxide layer forms upon exposure to steam, which can reduce the cladding corrosion kinetics by about two orders of magnitude with respect to Zr-based alloys as well as "conventional" stainless steels (e.g. 304L). This provides enhanced safety in the event of a loss of cooling. On the other hand, some of the isotopes in the steel, especially Fe and Cr, feature high neutron absorption cross-sections which lead to a significant reactivity penalty compared to Zr cladding. SiC cladding is under consideration for further improvements in accident tolerance while the lower absorption cross-sections of its constituents support achieving optimum neutron economy [8].

1.3 Reactivity Control

Reactivity control in the I^2S-LWR is achieved through soluble boron variations and use of burnable absorbers, as for standard PWRs. The Westinghouse Integral Fuel Burnable Absorber (IFBA)[9], a ZrB_2 coating applied on the fuel pellets, has been employed in the I^2S-LWR core design. IFBA is typically employed in Westinghouse-fueled PWR reloads due the favorable depletion rate and complete burnout with no residual reactivity penalty at the end of an irradiation cycle. IFBA compatibility with U_3Si_2 remains to be ascertained.

IFBA is applied on selected fuel rods of an assembly to accomplish the desired reactivity hold-down while obtaining well-behaved intra-assembly power distribution. Specific intra-assembly IFBA loading patterns devised for the I^2S-LWR 19×19 lattice include 84 and 156 IFBA rods loading patterns, corresponding respectively to 25% and 46% of the fuel rods of an assembly, as shown in Figure 2.

1.4 Fuel Stack

The active height region of the I^2S-LWR fuel axial stack is depicted in Figure 3. IFBA and non-IFBA fuel rods are shown. IFBA is present in the middle portion of the fuel stack, within a non-IFBA top and bottom 6-in region at full enrichment and top and bottom 6-in axial blankets at reduced enrichment. Non-IFBA rods have the same axial configuration, except for the absence of IFBA. The ^{10}B concentration used in the IFBA rods for the I^2S-LWR core design is 2.5 mg/in. For this analysis, a grid design based on Ref. [10] has been employed, consisting of a total of 8 grids, one ~1.5-in bottom grid and seven ~1.3-in intermediate grids. These grids are not depicted in Figure 3 but are modeled in the core physics simulations.

2 FUEL MANAGEMENT

2.1 Methodology

The core physics analysis supporting the I^2S-LWR core design has been performed with the Westinghouse core physics package NEXUS/ANC9[11]. PARAGON[12], and a 70-group library based on ENDF BVII.0 has been used for lattice data generation. A modified version of these codes to enable simulation of U_3Si_2 fuel has been employed. The same self-generating reloading scheme was repetitively applied for each fuel and core design until the main core parameters were converged and an equilibrium cycle satisfying the prescribed energy requirement was attained.

Past studies reported in [13] showed the I^{2}S-LWR performance for a 3-batch 12-month cycle with < 5 w/o ^{235}U enrichment. This study examines the fuel management options to achieve an 18-month cycle, maintaining the enrichment below the 5 w/o ^{235}U limit for commercial fuel.

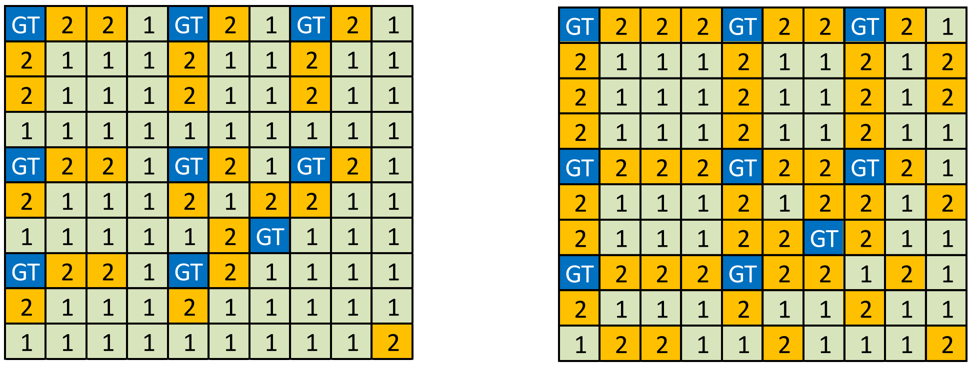

Figure 2 I^{2}S-LWR IFBA Loading Patterns: 84 (left) and 156 (right) IFBA rods

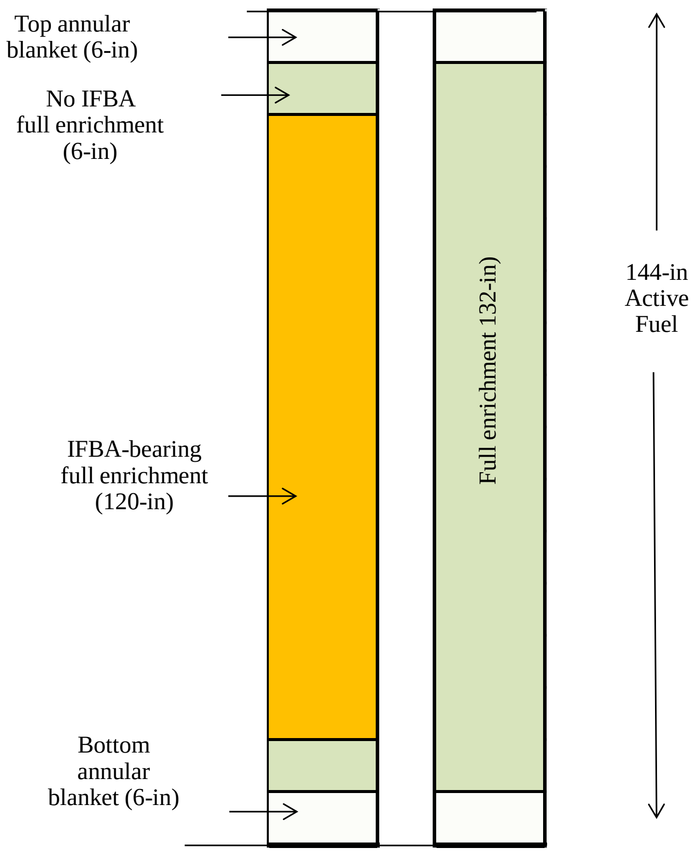

Figure 3 I^{2}S-LWR fuel axial stack, IFBA (left) and non-IFBA (right) rods - not to scale

2.2 Results

The I^2S-LWR core loading patterns devised for each fuel/cladding combination, U_3Si_2/FeCrAl, U_3Si_2/SiC and UO_2/Zr, are depicted in Figure 4. The key fuel management parameters and fuel cost results are presented in Table 3. The key assumptions used for the fuel cost calculation are given in Table 4.

In particular, Figure 4 shows the representative parameters of the core designs and shuffling schemes. In addition to the fuel loading pattern and prior cycle position of the burned fuel assemblies, this map shows the fresh fuel enrichment in the central part of the fuel stack (refer to Figure 3), the number of IFBA rods (with a ^{10}B linear loading of 2.5 mg/in ^{10}B) and the assembly-average burnup at the beginning of cycle (BOC). The fuel enrichment in the blanket region is 3.2 w/o ^{235}U.

The cores feature 52 (U_3Si_2/FeCrAl and UO_2/Zr) or 48 (U_3Si_2/SiC) fresh (“feed”) assemblies per reload out of a total 121 assemblies. A low-leakage loading pattern is implemented by positioning twice-burned assemblies at most of the outermost peripheral locations. A ring of fresh fuel assemblies inboard from the periphery, together with the use of burnable absorbers, allows balancing the power distribution in the radial direction. Axially, low-enrichment blankets are employed at both ends of the fuel stack to reduce neutron leakage from the central fully-enriched region.

It can be noted that the U_3Si_2/FeCrAl and UO_2/Zr cores rely on the same fuel loading pattern and shuffling scheme, except for the central core location which features fresh fuel every other cycle in the UO_2/Zr core. The UO_2/Zr fuel has a higher enrichment to compensate for the lower U content, but the lower cladding parasitic absorptions, and, to a smaller extent, the more favorable H/U and effective neutron thermalization, lead to lower ^{235}U/Reload, better fuel usage and ultimately 15% lower fuel cycle cost (FCC) relative to the baseline U_3Si_2/FeCrAl. On the other hand, the U_3Si_2/SiC core has 4 fewer feed assemblies, lower ^{235}U/Reload and best economic performance: 5% lower FCC compared to UO_2/Zr and 19% compared to U_3Si_2/FeCrAl. This is due to the low parasitic captures in SiC and, to a smaller extent, less detrimental H/U than in U_3Si_2/FeCrAl fuel due to the larger gap which lowers U content.

As a measure of comparison, and under consistent economic assumptions, the FCC for a 5% uprated 4-loop PWR with standard UO_2/Zr 17x17 Westinghouse fuel operating on an 18-month equilibrium cycle with a 76 feed (e.g. 2.5 batch) fuel management scheme and 4.7 w/o average ^{235}U enrichment is 7.6 $/MWhr-e. This is 4% lower than the FCC for the I^2S-LWR UO_2/Zr core, and is the net result of higher neutron leakages in the smaller I^2S-LWR core mitigated, but not offset, by the more efficient stainless-steel type I^2S-LWR reflector.

The main core physics parameters for the three equilibrium cycle cores are summarized in Table 5. The spectral index, defined as the ratio of the flux above and below 0.625 eV, follows the H/U ratio for the three cores, e.g. it is higher in the U_3Si_2/FeCrAl case, indicating a harder spectrum, and lower in the UO_2/Zr case, indicating a better neutron thermalization. In light of the relatively low discharge burnup (BU) of the U_3Si_2/FeCrAl core, a higher H/U and therefore a more thermalized spectrum would foster mild improvements in the utilization of the initial fissile inventory and thus a reduction in FCC. This however would be concurrent with higher power peaks and challenge on thermal limits that would ensue from a hypothetical fuel redesign with smaller cladding OD, larger H/U and more thermal spectrum.

U_3Si_2-FeCrAl
52 Feed Assemblies
Avg. ^{235}U 4.695
Disc. BU 42 GWd/tU
FCC 9.9 \$/MWhr-e

	7	8(6)	9(5)	10(4)	11(3)	12(2)	13(1)
7	2X 10-8 39217 54912	1X 5-11 21678 41060	Fd 4.8 -156 0 22920	1X 5-3 21646 41392	1X 7-12 20468 40809	Fd 4.8 -84 0 20701	1X 9-5 23336 33103
8(6)	1X 11-9 21678 41060	Fd 4.8 -156 0 22716	1X 3-8 22855 43083	1X 2-6 19109 39443	Fd 4.8 -156 0 23111	Fd 4.8 -84 0 19290	2X 3-3 33634 41184
9(5)	Fd 4.8 -156 0 22920	1X 6-11 22879 43118	Fd 4.8 -156 0 23588	1X 4-3 18952 40077	Fd 4.8 -156 0 21894	1X 6-6 22470 35413	
10(4)	1X 3-9 21646 41392	1X 6-2 19069 39435	1X 3-4 19003 40133	Fd 4.8 -156 0 23240	Fd 4.8 -84 0 19172	2X 2-9 35268 43157	
11(3)	1X 12-7 20468 40809	Fd 4.8 -156 0 23136	Fd 4.8 -156 0 21927	Fd 4.8 -84 0 19224	1X 4-4 22983 33771		
12(2)	Fd 4.8 -84 0 20701	Fd 4.8 -84 0 19331	1X 5-7 22674 35620	2X 2-5 35474 43404			
13(1)	1X 5-5 23336 33103	2X 1-7 32986 40606					

Times Burned/Feed	1X
Prev. Loc./Enrich. - # IFBA Rods	5-3
BOC Burnup (MWd/tU)	21646
EOC Burnup (MWd/tU)	41392

UO_2-Zr
52/53 Feed Assemblies
Avg. ^{235} 4.838
Disc. BU 53 GWd/tU
FCC 8.4 \$/MWhr-e

	7	8(6)	9(5)	10(4)	11(3)	12(2)	13(1)
	Fd 4.80 -156 0 30460	1X 5-11 29038 54683	Fd 4.95 -156 0 29487	1X 5-3 28896 52271	1X 7-12 27623 52502	Fd 4.95 -84 0 27725	1X 9-5 29856 42022
	1X 11-9 29038 54683	Fd 4.95 -156 0 30419	1X 3-8 30155 54534	1X 2-6 25851 50178	Fd 4.95 -156 0 30273	Fd 4.95 -84 0 25829	2X 3-3 43694 52653
	Fd 4.95 -156 0 29487	1X 6-11 30245 54635	Fd 4.95 -156 0 30092	1X 4-3 25561 51416	Fd 4.95 -156 0 29023	1X 6-6 28930 45077	
	1X 3-9 28896 52271	1X 6-2 25683 50091	1X 3-4 25694 51550	Fd 4.95 -156 0 30770	Fd 4.95 -84 0 25624	2X 2-9 45959 55158	
	1X 12-7 27623 52502	Fd 4.95 -156 0 30341	Fd 4.95 -156 0 29126	Fd 4.95 -84 0 25744	1X 4-4 30692 44003		
	Fd 4.95 -84 0 27725	Fd 4.95 -84 0 25956	1X 5-7 28794 45075	2X 2-5 45303 54690			
	1X 5-5 29856 42022	2X 1-7 41842 51002					

Times Burned/Feed	1X
Prev. Loc./Enrich. - # IFBA Rods	5-3
BOC Burnup (MWd/tU)	28896
EOC Burnup (MWd/tU)	52271

U_3Si_2-SiC
48 Feed Assemblies
Avg. ^{235}U 4.826
Disc. BU 55 GWd/tU
FCC 8.0 \$/MWhr-e

	7	8(6)	9(5)	10(4)	11(3)	12(2)	13(1)
	2X 2-9 45955 66038	Fd 4.95 -156 0 27340	1X 5-11 29004 50584	1X 5-3 28783 51102	1X 7-12 26083 51011	Fd 4.80 -84 0 26688	2X 7-5 50011 59148
	Fd 4.95 -156 0 27340	1X 6-7 26730 49532	1X 3-8 29945 52101	1X 2-6 25018 49123	Fd 4.95 -156 0 30628	Fd 4.95 -84 0 25540	2X 10-8 48640 56591
	1X 11-9 29004 50584	1X 5-5 28828 51248	Fd 4.95 -156 0 29477	1X 4-3 24922 51133	Fd 4.95 -156 0 29449	1X 4-4 30424 46419	
	1X 3-9 28783 51102	1X 6-2 24953 49225	1X 10-3 24988 51298	Fd 4.95 -156 0 31108	Fd 4.95 -84 0 25496	2X 10-9 50672 59460	
	1X 12-7 26083 51011	Fd 4.95 -156 0 30762	Fd 4.95 -156 0 29671	Fd 4.95 -84 0 25560	2X 2-5 45746 56943		
	Fd 4.80 -84 0 26688	Fd 4.95 -84 0 25606	1X 6-11 30079 46224	2X 9-10 50521 59388			
	2X 5-7 50011 59148	2X 8-10 48536 56506					

Times Burned/Feed	1X
Prev. Loc./Enrich. - # IFBA Rods	5-3
BOC Burnup (MWd/tU)	28783
EOC Burnup (MWd/tU)	51102

Figure 4 I²S-LWR Equilibrium Cycle Core Loading Patterns
(Fd: fresh fuel; 1X: once-burnt fuel; 2X: twice-burnt fuel)

Table 3 Key Fuel Management Parameters for the I^2S-LWR 18-month Equilibrium Cycle Core

Fuel Pellet	U_3Si_2	UO_2	U_3Si_2
Fuel Cladding	FeCrAl	Zr	SiC
Feed Assemblies (#)	52	52/53	48
Batches (#)	2.3	2.3	2.5
Avg. discharge BU (GWd/tU)	42	53	55
Avg. ^{235}U enrichment (w/o)	4.70	4.84	4.83
Heavy Metal (MT U/Reload)	35.1	27.8	26.8
^{235}U/Reload (kg)	1650	1347	1296
Total Fuel Cost (M$/Reload)	115.6	96.5	93.6
Delta Fuel Cost (M$/Year)	Ref.	-12.7	-14.6
FCC ($/MWhr-e)	9.9	8.4	8.0
Delta FCC (%)	Ref.	-15.1	-19.2

The boron content for the three cores is similar and in line with typical PWR reloads. If a low boron was desired a combination of burnable absorbers would likely be required (e.g. IFBA and burnable poison inserts, like WABA[9], or Gadolinia).

Both U_3Si_2/FeCrAl and UO_2/Zr core designs show a markedly benign cycle-peak radial peaking factor of respectively 1.433 and 1.462, attributable to a well-suited core design and reloading scheme and, for U_3Si_2/FeCrAl, the harder spectrum that tends to mitigate the impact of local heterogeneities and depletion-induced power redistribution. The radial peaking factors for U_3Si_2/SiC is higher, 1.563, and further optimization would be desirable for determining overall viability. The cycle-peak total peaking factors are well behaved in all cases.

The Moderator Temperature reactivity coefficient (MTC) is negative across power range and depletion cycle of the (harder spectrum) U_3Si_2/FeCrAl core; a slightly positive HZP MTC is observed for UO_2/Zr and U_3Si_2/SiC during the initial part of the cycle, in correspondence of the soluble boron peak induced by IFBA depletion. This is likely acceptable but a reduction can be pursued including burnable poison inserts (e.g. WABA).

The Doppler Temperature Coefficient is very similar for all cores, about -1.6 pcm/F at BOC and -1.8 to -2.0 pcm/F at EOC. The Doppler power coefficient (DPC) is higher (e.g. less negative) in U_3Si_2, especially with FeCrAl, due to the lower fuel operating temperature from the higher thermal conductivity of fuel (and cladding if compared to SiC). This implies a lower power defect compared to UO_2, which is beneficial to shut-down margin and may be operationally advantageous for the reduced reactivity reserve required for return to power and load following operations.

Table 4 Assumptions for Fuel Cycle Cost Calculation
(Long-term Prices used for U_3O_8, Conversion and Enrichment)

U_3O_8 Price ($/lb)	$50
Conversion Price ($/kgUn)	$12
SWU Price ($/SWU)	$140
Fabrication Price ($/kgU)	$200
Pre-Operational Interest (%/Yr)	6.0%
Spent Fuel Cooling Time (Months)	120
Spent Fuel Disposal Charge ($/MWhre)	$1
Spent Fuel Dry Storage Charge ($/Fuel Assembly)	$50,000
Cycle Length (Months)	18
Rated Thermal Power (MW_t)	2,850
Rated Net Electric Output (MW_e)	940
Inflation Rate	2.0%
Return on Fuel Investment (%/Yr)	8.0%

Table 5 Key Core Physics Parameters for the I^2S-LWR
18-month Equilibrium Cycle Core

Fuel Pellet	U_3Si_2	UO_2	U_3Si_2
Fuel Cladding	FeCrAl	Zr	SiC
Spectral Index (BOC, HFP)	12.9	9.7	10.1
BOC, HZP no Xe CBC (ppm)	2594	2355	2514
BOC, HFP eq. Xe CBC (ppm)	1770	1622	1781
HFP eq. Xe CBC Peak (ppm)	1788	1708	1808
Radial Peaking Factor, FdH (peak)	1.433	1.462	1.563
Total Peaking Factor (peak)	1.704	1.733	1.869
HZP MTC (pcm/F) (peak)	-3.66	-0.01	0.20
HFP MTC (pcm/F) (peak)	-12.11	-9.75	-8.44
HFP DTC (pcm/F) – BOC, no Xe	-1.64	-1.62	-1.56
HFP DTC (pcm/F) – EOC	-2.08	-1.83	-1.84
HZP DPC Eq. Xe (pcm/% Pow)	-9.68	-19.19	-16.55

3 CONCLUSIONS

An 18-month equilibrium cycle core design has been devised for the I^2S-LWR which implements an efficient fuel management scheme while satisfying top-level safety limits, including peaking factors and shut-down margin. The baseline fuel design is a 19×19 square lattice U_3Si_2 fuel pellet in advanced FeCrAl steel cladding. The fuel active length is 144-in with top and bottom axial blankets. IFBA is used as the fuel burnable absorber. The fuel management is a 2.3-batch with ^{235}U concentrations of 4.7 w/o, and 3.2 w/o ^{235}U blankets, for an assembly-average discharge burnup of 42 GWd/tU.

A core design implementing UO_2 fuel with Zr cladding has also been developed for accelerated deployment of the I^2S-LWR concept. From the core design standpoint, the main difference compared to the U_3Si_2 core is the higher enrichment, 4.95 w/o ^{235}U in UO_2 which compensates the lower U content of UO_2 vs. U_3Si_2 and reflects in the higher discharge BU, 53 GWd/tU. Some differences in the physics behavior are noted and ascribed to the harder neutron spectrum in U_3Si_2 or to its lower operating temperature compared to UO_2 fuel (more favorable radial power peak in U_3Si_2, more negative DPC in UO_2, larger shut-down margin in U_3Si_2). None of these reactor physics differences constitute a decisive advantage or disadvantage in determining the feasibility of either fuel option. The more efficient U usage, mostly from lower parasitic captures in Zr vs. FeCrAl, should be noted. This reflects in ~15% lower FCC of UO_2/Zr vs. U_3Si_2/FeCrAl.

Finally, a U_3Si_2 fuel SiC cladding fuel and core design has been developed operating on a 2.5 batch fuel management scheme, with 4.83 average ^{235}U enrichment and 55 GWd/tU average discharge burnup, reactor physics characteristic intermediate between the two other cores, and definite fuel cycle cost advantages: 4% lower fuel-related electricity cost than the UO_2/Zr and 19% lower than U_3Si_2 with FeCrAl cladding. The lower fuel cost compared to UO_2 derives from the higher U content and better fuel management options that it allows. The fuel cost advantages compared to U_3Si_2 with FeCrAl cladding are mostly due to significantly lower parasitic captures than in the FeCrAl cladding with the more favorable H/U as a secondary contributing factor.

In summary, U_3Si_2 with FeCrAl or SiC cladding as well as UO_2 with Zr cladding appear all feasible options for the I^2S-LWR from a core design perspective. Safety evaluations, including transient analyses that are currently being performed, will provide a better assessment on the ultimate viability and relative inherent safety of these fuel options.

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