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SNAP and AI Fuel Summary Report

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MASTER

Abstract

The SNAP and AI Fuel Summary Report provides a detailed overview of treatment and storage of these fuels from fabrication through current storage including design parameters and reactor history. Chemical and physical characteristics are described, and potential indicators of as-stored fuel conditions are emphasized.

Acronym and Abbreviation List

AI	Atomics International
BOL	Beginning of Life
cc	cubic centimeter
FRC	Fuel Receipt Criteria
ICPP	Idaho Chemical Processing Plant
INEL	Idaho National Engineering Laboratory
kw	kilowatt
m.a.%	metal atom percent
MTR	Materials Test Reactor
Mw	Megawatt
Mw(t) hrs.	Megawatt (thermal) hours
Na	Sodium
NaK	Sodium Potassium
OD	Outside Diameter
ppm	parts per million
SCA	SNAP Critical Assembly
SCB	a thin ceramic liner, not explicitly defined in the available references
SER	SNAP Experimental Reactor (see also S2ER)
SETF	SNAP Experimental Test Facility (see also S2DR)
SNAP	Systems for Nuclear Auxiliary Power
SNAPSHOT	the flight test part of the SNAP 10A program
SNAPTRAN	SNAP TRANsient
Sp. g	Specific gravity
STE	Shield Test Experiment (see also STF and STIR)
STF	Shield Test Facility (see also STE and STIR)
STIR	Shield Test and Irradiation Reactor (see also STF and STE)
S2DR	SNAP-2 Developmental Reactor (see also SETF)
S2ER	SNAP-2 Experimental Reactor (see also SER)
S8DR	SNAP-8 Developmental Reactor
S8ER	SNAP-8 Experimental Reactor
TAN	Test Area North
wt.	weight
10FS-3	SNAP 10 Flight System 3 Reactor

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Introduction

The SNAP Program was conducted by Atomics International at the Santa Susana Nuclear Development Field Laboratory located about 30 miles northeast of Los Angeles, California.[1] The SNAP program was intended to provide electrical power systems for satellites. This program supported work in two areas of parallel development: use of radionuclides and use of nuclear reactors each to provide the heat to generate electricity. The radioisotope systems developed were labeled with odd numbers (i.e. SNAP-1) and the reactor systems with the even numbers (i.e. SNAP-2).

Fuel Names and General Fuel Type

The SNAP and AI fuels are stored in aluminum cans in the CPP-603 basins at the Idaho National Engineering Laboratory (INEL); the fuels themselves are uranium-zirconium hydride rods.[2]

The following acronyms refer to specific SNAP reactors or fuel types. The term SNAP refers to Systems for Nuclear Auxiliary Power in general; it also refers specifically to fuel cans SN-1 through SN-20 (can SN-6 does not exist). In general, AI refers to Atomics International, the contractor responsible for the SNAP Program; AI also refers specifically to fuel cans AI-1 through AI-12. Generally the fuels are referred to by the acronyms for their respective reactors. Some experiments were conducted where prototype fuels were irradiated in test reactors; these are usually referenced by experiment number. Six types of SNAP fuels are stored at the Idaho Chemical Processing Plant from SER, S2DR, 10FS-3, S8ER, S8DR and STF. SER stands for SNAP Experimental Reactor, sometimes called the SNAP-2 Experimental Reactor (S2ER). S2DR stands for SNAP-2 Developmental Reactor; SETF stands for the SNAP Experimental Test Facility and is used interchangeably with S2DR. 10FS-3 refers to the SNAP 10 Flight System 3 Reactor (a part of the SNAP 10A program which included the SNAPSHOT flight test). S8ER stands for the SNAP-8 Experimental Reactor. S8DR stands for SNAP-8 Developmental Reactor. (S8ER and S8DR are different reactors, as are S2ER and S2DR which are often referred to as SER and SETF.) STF refers to Shield Test Facility; STIR stands for Shield Test and Irradiation Reactor which is used interchangeably with STF. The original STF was also called the Shield Test Experiment, and some of the older documents referred to it as the STE.

Other common acronyms include SNAPTRAN for SNAP TRANsient and SCA for SNAP Critical Assembly; but these references do not always apply to the fuels in the SNAP and AI cans in storage at the Idaho Chemical Processing Plant (ICPP) at the Idaho National Engineering Laboratory (INEL).

Reactor Design and Background

SER was the original SNAP-2 experimental reactor. It was built and operated to demonstrate the feasibility of a hydride moderated compact reactor system.[3] Type 347 stainless steel tubing was used for cladding to protect the fuel element assembly from attack by liquid sodium (Na, the heat transfer medium for the core), to provide a thermal expansion coefficient close to that of the fuel rod alloy, and to withstand the operational environment for periods of at least one year at 1200°F. A Solaramic S-1435A glass bonding material was developed to coat the inner surfaces of the cladding and the end caps, to prevent hydrogen loss in excess of 1% per year for reaction control. Hastelloy B was considered as a potential cladding material, but ability to fabricate quality tubing was questionable due to cracking along seam welds, and to the ceramic coating becoming porous with formation and sublimation of molybdenum oxide during firing.[4] Beryllium plugs were also included in the SER fuel assemblies as end reflectors. The reactor core consisted of 61 fuel assemblies in a hexagonal array.[5] (See Figures 2&3 in Appendix A.)

S2DR was the second reactor, designed and constructed to demonstrate the operability of a complete power plant system. Fabrication processes were refinements of the SER system. Hastelloy N tubing and end caps were introduced for cladding for better material properties than the 347 stainless steel and better workability than the Hastelloy B. The glass coating was adapted to include a burnable poison Sm_2O_3, and the Hastelloy N cladding was chromized (with Solar Aircraft's F3-78 chromizing process) to provide a diffusion layer barrier to the formation of the molybdenum trioxide during firing.[3,4,6] Beryllium oxide end reflectors were included in the S2DR fuel assemblies. Four of the fuel assemblies were instrumented with thermocouples to measure maximum fuel meat temperature. The reactor core consisted of a hexagonal array of 37 fuel assemblies eight inches across flats and nine inches across corners surrounded by beryllium reflector shims.[6] The primary coolant was changed from sodium to the eutectic sodium-potassium alloy, NaK-78 (22% sodium, 78% potassium), based on experience with the SER.[7,8] (See Figures 4-6 and Table 2 in Appendix A.)

The 10FS-3 reactor was an adaptation of the SNAP-2 reactors for use in meteorological and military reconnaissance satellite applications. Nuclear reactors, particularly those with hydride fuels, were considered promising due to their high power to weight ratio.[9] 10FS-3 set the record for the longest continuous operation of a nuclear reactor system in the free world with its 10,000 uneventful hours of operation.[10] 10FS-3 operated in a simulated space environment on the ground; 10FS-4, another similar reactor, was launched as part of the SNAP 10A program. An end cup was added within the cladding to help prevent hydrogen loss. End reflectors were eliminated, and the active fuel length was extended proportionally. Also, 0.15 wt. % carbon was added to the fuel alloy to minimize the hydrogen permeation rates which lead to leakage while maximizing the hydriding yield (the amount of the hydrogen which the zirconium can accept).[11] (See Figures 7&8 in Appendix A.)

The SNAP-8 nuclear tests were a direct extension of the technology developed for the SNAP-2 and SNAP-10A programs. SNAP-8 reactor cores held 211 fuel assemblies and were designed for higher temperature and power operation. The S8ER test objectives were to demonstrate operation at 600 kw with 1300°F outlet temperature, 60 day operation at 450 kw with 1300°F outlet temperature, and nuclear parametric tests. Additional 900°F outlet temperature runs were undertaken to measure the samarium burnout. Nuclear power coefficient tests were done during which the core was subjected to about 115 rapid changes in power (100 kw in 1 minute). About 80% of the S8ER fuel elements had cladding cracks at the time of reactor disassembly; one element was broken into three pieces. Cladding fractures were believed to be due to a combination of thermal cycling, fuel swelling, and loss of ductility in the Hastelloy N cladding, compounded by loss of hydrogen from breach of the ceramic bonding coat.[12] (See Figures 9&10 in Appendix A.)

The S8DR and associated control components were tested in a vacuum chamber to simulate operating conditions in space. The primary purpose was operating experience at rated conditions and verification of flight-rated hardware design. The S8DR system was based on the S8ER system with several refinements. The major changes were use of longer fuel rods, an improved ceramic bonding material called SCB-1, additional clearance between fuel meat and cladding, and an improved core coolant flow profile. Slight alterations were also made to the fuel alloy.[13, 14, 15] Historical data on zirconium-uranium hydride fuel growth from prior SNAP fuel irradiation experience was studied and applied to S8DR design.[16] S8DR was designed for an operating life of 12,000 hours, but an administrative decision was made to shut down after 7000 operating hours to determine the cause of fuel cladding ruptures indicated by fission products in the coolant and increases in the reactivity loss rate. About a third of the fuel elements had cracked cladding. Data interpretation concluded that ruptures were the result of cladding strain due to fuel swelling from temperatures exceeding design values. Element bowing also influenced the hydraulic distribution of the NaK coolant to the detriment of element to coolant heat transfer. Copper content greater than 150 ppm in the fuel correlated with reduced fuel growth.[17] (See Figures 11-13 in Appendix A.)

The SNAP Shield Test Facility was constructed for the radiation evaluation of shield materials and geometries for the SNAP reactor development program. In addition to shield tests, the reactor was used to support a number of other programs, including radiation damage, reactor physics, fuel material, radiochemistry, and instrumentation research. The original facility consisted of: a 50 kw water-cooled zirconium hydride uranium reactor, a neutron thermal column, a fission source plate, and associated equipment.[18] The STIR facility was modified in 1964 to accommodate a new core designed to provide a maximum power of 1 Mw. The upgrade included a change to MTR (Materials Test Reactor) plate type fuel.[19, 20] The STF fuel in storage at the INEL is from the original 50 kw core.[2] The 50 kw core was designed to use 63 rejected SER elements with an average loading of 5.69 x 10^{22} hydrogen atoms per cc of fuel. The first configuration, having the 60 elements in an 86 rod alternating ten and nine by nine square symmetrical array with one PuBe source element, four control/safety rod thimbles, and the remaining positions of water filled dummies, was not sufficient to drive the fission plate. Fifty-six fuel elements were selected to attain an average hydrogen loading of 5.90 x 10^{22}, and 16 BeO rods were introduced for a second configuration which was used successfully.[21] (See Figures 14-17 in Appendix A.)

Chemical and Physical Characteristics of the Fuel

Table 1: Fuel Specifications [7, 14, 16, 22, 23, 24, 25, 26]

Dimension	SER	S2DR	10FS-3	S8ER	S8DR	STF
Carbon	None	None	0.15 wt%	0.4 wt%	0.15 wt%	None
Assembly Base Length	14"	13.23"	12.450"	14.470"	17.5"	16.25"
Nominal Assembly Weight	960 g	1500 g	1550 g	370 g	~450 g	800 g
Active Fuel Length	10"	10"	12.250"	14"	16.825"	10"
Nominal Active Fuel Weight (UZrH)	722 g	1140 g	1388 g	310 g	365 g	650 g
Active Fuel Diameter	0.975"	1.212"	1.212"	0.534"	0.529"	0.925"
End Reflectors: material length diameter	Be Metal 1.5" 0.975"	BeO 1.50" 1.211"	None	None	None	None
U-235 Form 93%enrichment (wt. % given)	93Zr-7U hydride	90Zr-10U hydride	90Zr-10U hydride	90Zr-10U hydride	89½Zr-10½U hydride	93Zr-7U hydride
BOL U-235 per element	49 g	105 g	128 g	31 g	34 g	47.5 g
Ave. H atoms per cc of fuel x 10^{22}	6.40	6.45	6.34	5.95	6.07	6.02
Nominal Burnup*	0.010m.a.%	0.025m.a.%	0.023m.a.%	0.20m.a.%	0.13m.a.%	0.005m.a.%
Power Level (kw)	50	50	40	600	600 or 1000	50
Coolant: Type Outlet Temperature	Na 1200°F	NaK-78 1200°F	NaK-78 1000°F	NaK-78 1300°F	NaK-78 1300°F or 1150°F	pool water 65°F
Total Energy Generated(Mw(t) hrs.)	225	273	383	$5.1x10^3$	$4.35x10^3$	46.1
Total hrs. of Critical Operation	6035	11,290	10,075	12,000	7000	Unknown
Cladding: Material	347 SS	Chromized Hastelloy-N	Chromized Hastelloy-N	Chromized Hastelloy-N	Chromized Hastelloy-N	6061 Al
OD	1"	1.250"	1.250"	0.560	0.553	1"
Thickness	0.010"	0.014"	0.015"	0.010"	0.0113"	0.028"
Bonding Coat: Material	Solaramic S-1435A	Solaramic S1435-SM2	Solaramic S1435-SM2	Al Al-8763D	SCB SCB-1	None
Thickness	0.025"	0.0035"	0.0035"	0.0025"	0.002"	
Sm_2O_3	no	yes	yes	yes	yes	
Internal Atmosphere	He-Air Mixture	He-Air Mixture	0.1 atm He	0.1 atm He	Vacuum	Unknown
# Rods per Core	61	37	37	211	211	60 or 56

* Nominal Burnup values (given in metal atom percent, or m.a.%) are composites of values given in references for average, peak, and nominal burnup from both post-irradiation analysis and design data. For details and background on the available burnup data see Appendix B.

Fuel History

In general, the SNAP reactors were experimental in nature, and historically, the fuel handling sequence was similar for all six reactor fuels. These fuel elements were developed and assembled by Atomics International. The reactor operations and testing are well documented with the exception of the STF reactor. (Shield test documentation was on a test by test basis, and the corresponding reactor operating information is difficult to find.) Within a few months of shutdown, reactors were disassembled (either on site or after having been transported whole to the AI Hot Laboratory), and select elements were examined in extensive postirradiation studies.

The elements were often cleaned and/or treated specially as part of the post-irradiation examination. Density measurements of SER elements 10R8 and T9 were taken using octyl alcohol. The overall analysis indicated some general conclusions: radial cracking of the SER fuel was observed, but not considered to have affected fuel performance, a small change in density observed was attributed to microcracking, and the hydrogen permeation leak rate was discredited due to unreasonable results presumed due to rough fuel handling during reactor disassembly.[5] Although the SER fuel performance was satisfactory, and the fuel was considered to be in good condition, the cracking previously noted may compromise fuel integrity in storage with age.

Generally, the S2DR elements were considered to be in excellent condition. The cladding on S2DR elements 39 and 50 (core positions IV-6 and IV-15) had beryllium reaction zones adjacent to the internal core reflectors at the bottom end caps where weld cleaning machining marks were evident; the reaction area (⅛" in diameter) penetrated about 0.003", and did not affect the fuel meat.[3, 6]

Upon removal from the reactor core, all 10FS-3 elements were marked on the cladding top cap to indicate its orientation in the core. They were subsequently "soaked in Dowanol, brushed clean with a soft fiber brush, and stored and handled in a six-element fixture...." The 10FS-3 elements were also considered to be in excellent condition. Element 529 showed a slight aberration in the original eddy current test with cladding intact, but the detailed examination did not reveal a conclusive explanation. The abnormality was not shown in subsequent tests on the bare fuel and cladding shell. Metallography revealed "minor microcracking" which was not considered significant since it was commonly seen in unirradiated fuel from the hydriding process.[22] The effects of microcracking on fuel integrity over time is unknown.

During reactor disassembly, all S8ER elements were visually identified by number and marked on the top end pin to indicate its orientation in the core. Each element "was washed with ethylene glycol n-butyl ether to remove the NaK oxide deposits." The S8ER elements showed cladding cracks on 167 out of the 211 elements in the core. Cladding fractures were attributed to a combination of thermal cycling, subsequent fuel swelling, and embrittlement of the Hastelloy N cladding, compounded by loss of hydrogen from breach of the ceramic bonding material. Fuel meat was fractured in many of the elements which were declad for examination. Some problems were noted in the elements that had cracked cladding: the ceramic reacted with the NaK, spalled from the cladding, and in some cases adhered to the fuel meat.[12]

Upon disassembly of the S8DR core, a thin, highly adherent, magnetic, metallic film was observed on fuel element external surfaces. Each element was cleaned. The S8DR elements showed cladding cracks on 72 out of the 211 elements in the core. The same problems as the S8ER were noted in those elements that had cracked cladding: often the fuel meat was fractured, the ceramic barrier reacted with the NaK, spalled from the cladding, and in some cases adhered to the fuel meat. Select fuel samples were immersed in monobromobenzene to determine density.[17]

Some fuels were stored by Atomics International until July 1966 when the first shipment was sent to ICPP. Within a few months of their arrival at the INEL, the SNAP fuels were transported to the Test Area North (TAN) Hot Cell for decladding, recanning and return to ICPP. None of the AI fuels were declad or recanned at TAN until late 1973. One shipment (shipper's cans numbered DR#1 through DR#8) was stored (probably at TAN) in the shipping cans for 27 months. The AI fuels were received back at ICPP in September of 1974. The original intent was for these fuels to be reprocessed, but they remain in underwater storage at ICPP to date.[2]

There are 19 (3½" diameter, 36" long, aluminum) SNAP cans including fuels from S2DR, SER, 10FS-3, STF and S8ER fuels. There are also 12 (2" diameter, 42" long, aluminum) AI cans including SNAP fuel from S8ER and S8DR. The SNAP fuel cans contain the earlier reactor fuels and have been in storage for 5-7 years longer. SNAP and AI fuels are not otherwise different.[2]

SNAP and AI can information is limited. SNAP cans were described as nominal 3½" outside diameter schedule 5 standard aluminum cans "with the ears removed ... by cutting approximately two inches off the top of each can."[27, 28] Lids, provided separately, were remotely welded in place after the cans were filled with fuel. Modified cans were about 36" long with approximately 0.083" thick walls.[27, 29, 30, 31] These cans were recommended "because of their availability and because of economic considerations."[27] Two references described the can as "schedule 5 S" aluminum instead of "schedule 5".[32, 33] The "S" is an unknown designator. The available evidence is not conclusive, but a reference text suggests that "S" indicates stainless steel pipe dimensions while most otherwise undesignated schedules are based on carbon steel pipe dimensions.[34] The stainless steel dimensions indicate thinner walls than carbon steel, and current aluminun pipe tolerances agree with the stainless steel basis, with nominal wall thickness 0.083", same as the SNAP cans. "Standard" is another likely interpretation. Aluminum pipe specifications do not appear to indicate composition (i.e. high sulfur), strength, seamed, standard, or any other descriptive delineation with an "S". The "S" may have been a typographical error.

Less information is available on the AI cans. They were constructed from 43" long sections of 2" diameter aluminum pipe available at the INEL. The cans were sealed with "a plug welded in one end and the opposite end closed with a standard aluminum pipe coupling and plug. A bail of ⅛" aluminum rod is attached to the pipe plug."[35] No schedule was indicated, and initial wall thickness of the AI cans is unknown. The original evaluation of AI cans in the "A" Rack assumed a 2" outside diameter and a ⅛" thick wall.[30] The Criticality Safety Evaluation (CSE) assumed a 2.07" inside diameter and wall thickness of 0.154" (corresponding to schedule 40 pipe dimensions).[29,34]

Several fuel elements in the AI cans had been noted as having contained NaK at the time of decladding and recanning at the TAN Hot Cell. These elements were reportedly soaked in water until visible reaction stopped and then recanned.[35] Four of these NaK filled elements were from shipping can DR#4 and were recanned in either can AI-1, AI-3, or both. Five more of these elements were from shipping can DR#1 and were recanned in either can AI-3, AI-4, or both. Three more elements from DR#6 had NaK in them and were recanned in AI-4, AI-5, AI-8, or some combination thereof (only one element from DR#6 was placed in AI-8).[2] "Capsules AI-6, AI-7, & AI-8 were filled with water and closed."[36] Available information is not clear whether this was standard procedure or unique treatment for the NaK intrusion. Judging from the S8ER and S8DR post-operation examinations, the NaK contamination problem may have been wide spread due to extensive cladding cracking during reactor operations; any cracks severe enough to breach the cladding could have exposed fuel meat to the NaK coolant.[12, 17] Galvanic can corrosion is very likely where fuel elements were canned wet.

Correlations between fuel receipt data and reactor core element loading are generally good; nearly all of the elements from each of the reactor cores can be accounted for:

With 61 elements from the complete SER core, 54 can be accounted for in the fuel receipt criteria (FRC). Elements 10R8, M4, T9, U10, and 10R5 were canned with the Organic Moderated Reactor fuel at AI and were not sent to the INEL.[2, 5]

A complete core loading of 37 S2DR elements can be accounted for in the FRC; all 37 of them can be identified by element number from the shipping logs.[2, 3]

The fuel receipt criteria identifies all 37 10FS-3 elements by number.[2, 22] However, comparison of records suggests that several errors have been propagated in the FRC documentation: fuel elements 322, 388, 316 and 524 in the fuel receipt criteria do not exist in the core and are probably 332, 338, 136, and 529 of the 10FS-3 core, respectively .

The S8ER core contained 211 elements; the fuel receipt criteria identified 210 of them.[2, 12] Element 476, one of the destructively analyzed S8ER elements, is not mentioned in the FRC; elements 412, 171, and 528 appear twice; and element 402 did not appear. Elements 171 and 528 appear to be fragments of elements split between the two containers. The 412 identified with the contents of shipment S8ER 3 was probably 402 based on the relative core positions of the elements in that shipment, particularly since both 412 listings weighed enough to be complete elements.

A complete core loading of 211 S8DR elements are identified in the FRC, but 8-22 and 9-5 were not found, and elements 4-5, 8-5, and 8-12 were recorded twice. The 8-5 pieces are 327 g and 12 g each, suggesting that they are probably portions of the same element. However the two 4-5 entries are 359 g and 365 g each, suggesting that they are in fact two different elements (probably 4-5 and 9-5). Similarly, the two 8-12 pieces were 364 g and 365 g and may actually be elements 8-12 and 8-22.

61 of the 63 distinct STF elements shown in the initial and revised core maps are identified in the FRC. Element B1 from core 1 position 6-3 and element A39 from core 1 position 5-13 did not appear in the fuel receipt criteria; neither element was referenced in the revised core.

The SNAP fuel cans were located in CPP-603, both in the South Basin 901 rack and in yokes in the Middle Basin. The fuel receipt criteria indicates that the SNAP fuel cans had previously been stored in buckets in CPP-603. The AI fuel cans were all located in the 901 rack of the South Basin. The SNAP cans were badly degraded, and the integrity of can SN-20 had already been compromised.[37, 38] AI fuel cans appeared to be intact but were also considered suspect.[2, 39, 40] Fuel meats from S8ER and S8DR elements are considered to be physically degraded (rubble) based on the available post-operation examinations.[12, 17]

The SNAP and AI fuels have been recanned to ensure containment. The aluminum cans were placed in stainless steel outer cans constructed of 5" schedule 40 pipe (nominal 5.047" inside diameter, 5.563" outside diameter, and 0.258" wall thickness) with a 0.5" bottom plate and a bolted flanged lid attached with two bolts. The without lids the outer cans for the SNAP fuels are 45.0" long, and the outer cans for the AI fuels are 49.1" long. Each SNAP and AI outer can has a lifting bail made of round bar attached to the ¾" thick lid plate with two swivel blocks. The lid closure was designed to prevent exchange of suspended solids with pool water, but does not provide a complete seal. These fuels will be moved to another storage facility during the CPP-603 Fuel Relocation.[41, 42, 43]

An itemized list of SNAP and AI fuel can contents and storage locations has been developed from the Fuel Receipt Criteria in conjunction with the other references cited in this report. This information can be found in Appendix C.

Time Line

Figure 1: SNAP Program Chronology

This time line gives a frame of reference for the activities involving the SNAP and AI fuels in storage at the ICPP which took place during the SNAP program. Many of the dates are imprecise, but the general chronology of events is correct based on the available documentation from that period.

1958	Fabrication of SER (and STF) fuel elements
Sept 19, 1959	SER first critical operation
1960	Fabrication of S2DR fuel elements
Nov 19, 1960	SER test program concluded
1st ½ of 1961	SER disassembled
April 1961	S2DR first critical operation
2nd ½ of 1961	SER select element examinations (elements M-4, 10R8, T-9, X-7, 10R5, Q-5, U-10)
Oct 9, 1961	STF first critical operation
Dec. 1962	S2DR test program concluded
1962 - 1963	Fabrication of S8ER fuel elements
1st ½ of 1963	S2DR disassembled
2nd ½ of 1963	S2DR select examinations at AI Component Development Hot Cell (elements 26, 48, 34, 30, 38, 39, 22, 50)
Nov 22, 1963	S8ER first critical operation
1963 - 1964	Fabrication of 10FS-3 fuel elements
May 22, 1964	STF shut down for upgrade, original core disassembled
Jan 22, 1965	10FS-3 first critical operation
Apr 15, 1965	S8ER test program concluded
July 28, 1965	S8ER shipped whole to Atomics International Hot Laboratory
Aug - Sept 1965	S8ER disassembled
mid'65 - mid'66	S8ER select element examinations (elements 206, 340, 302, 111, 293, 378, 188, 316, 432, 332, 491, 525, 410, 476, 388, 232, 309, 519, 398, 351, 486, 492, 181, 335, 474, 342)
Mar 15, 1966	10FS-3 test program concluded
Apr - Jun 1966	First set of SNAP fuels shipped to INEL (included S2DR, SER and STF)
2nd ½ of 1966	10FS-3 shipped whole to AI Hot Laboratory and disassembled
1st ½ of 1967	10FS-3 select element examinations (elements 440, 482, 435, 422, 331, 529)
1967 - 1968	Fabrication of S8DR fuel elements
Apr - Jun 1968	Second set of SNAP fuels shipped to INEL (included 10FS-3, S8ER and residual S2DR)
Jan. 1969	S8DR first critical operation
Apr - Jun 1969	Third set of SNAP fuels shipped to INEL (included S8ER and residual 10FS-3 and SER)
Dec. 1969	S8DR test program terminated
March 1970	S8DR shipped whole to AI Hot Laboratory
1970 - 1971	S8DR disassembly and select element examinations (detailed testing of 48 elements)
Jun - Jul 1971	Fourth set of SNAP (AI) fuels shipped to INEL (included S8DR only)
Feb - Mar 1973	Last set of SNAP (AI) fuels shipped to INEL (included residual S8ER and S8DR)
July 23, 1993	SN-20 can failed during rerigging operation
1st ½ of 1994	SNAP and AI fuel cans placed in stainless steel outer cans

Anomalies

A number of practices unique to SNAP and AI fuels have been identified. The accuracy and completeness of documentation is imperfect, but items are outlined and explained to the extent possible based on the available historical information.

Several of the elements were instrumented with thermocouples extending about an inch into the fuel meat, specifically: SER elements M4, 10R8, T9, and 10R5, (none of which are stored at the INEL)[5] and S2DR elements 58, 67, 72, and 73.[3] S2DR elements 60, 76, 79, and 80 had thermocouple holes, but 80 was not used in the S2DR core, and the others were not instrumented during use.[3]

One 10FS-3 element, 482, was sectioned with the cladding on (presumably as part of the destructive analysis at Atomics International).[44] Cladding is assumed to have been removed from the pieces and from the complete elements at TAN prior to recanning. The "fuel data" appears to have been transmitted from AI through TAN to ICPP and pertains to the fuel as shipped from AI not as shipped from TAN.

SNAP can SN-6 does not exist. The can appears to have been intended to hold the remaining 18 elements from the SER. These SER elements were shipped at a later date with the S8ER fuel and were packed in can SN-20.[2] Two TRIGA elements were also included in SNAP can SN-20 along with some S8ER elements and elements from SNAP irradiation experiments NAA-117-1, NAA-115-2, NAA-82-1, NAA-67-2, and NAA-67-20 conducted in the Materials Test Reactor.[2, 16, 31, 45]

SNAP irradiation test elements NAA-121-1, NAA-121-2, NAA-121-3, and NAA-121-4 were included in fuel can AI-10 with the S8ER and S8DR fuels. Five remaining pieces from irradiation test NAA-117-1 and two SNAP archive elements, 335 and 564, were included with the S8DR in fuel can AI-12. Little other information is available on these fuels.

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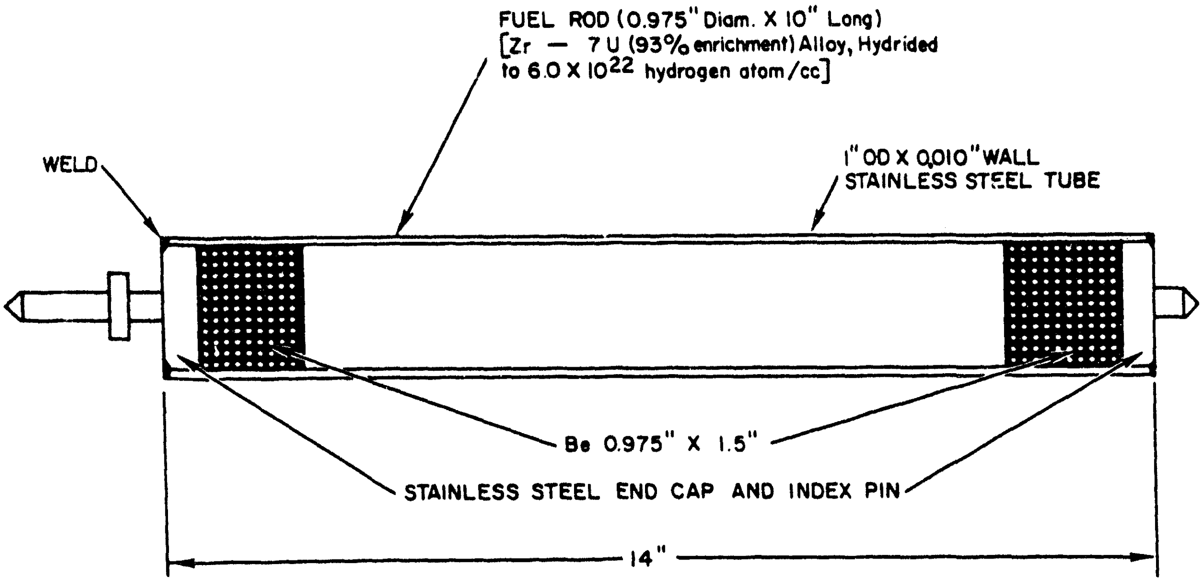
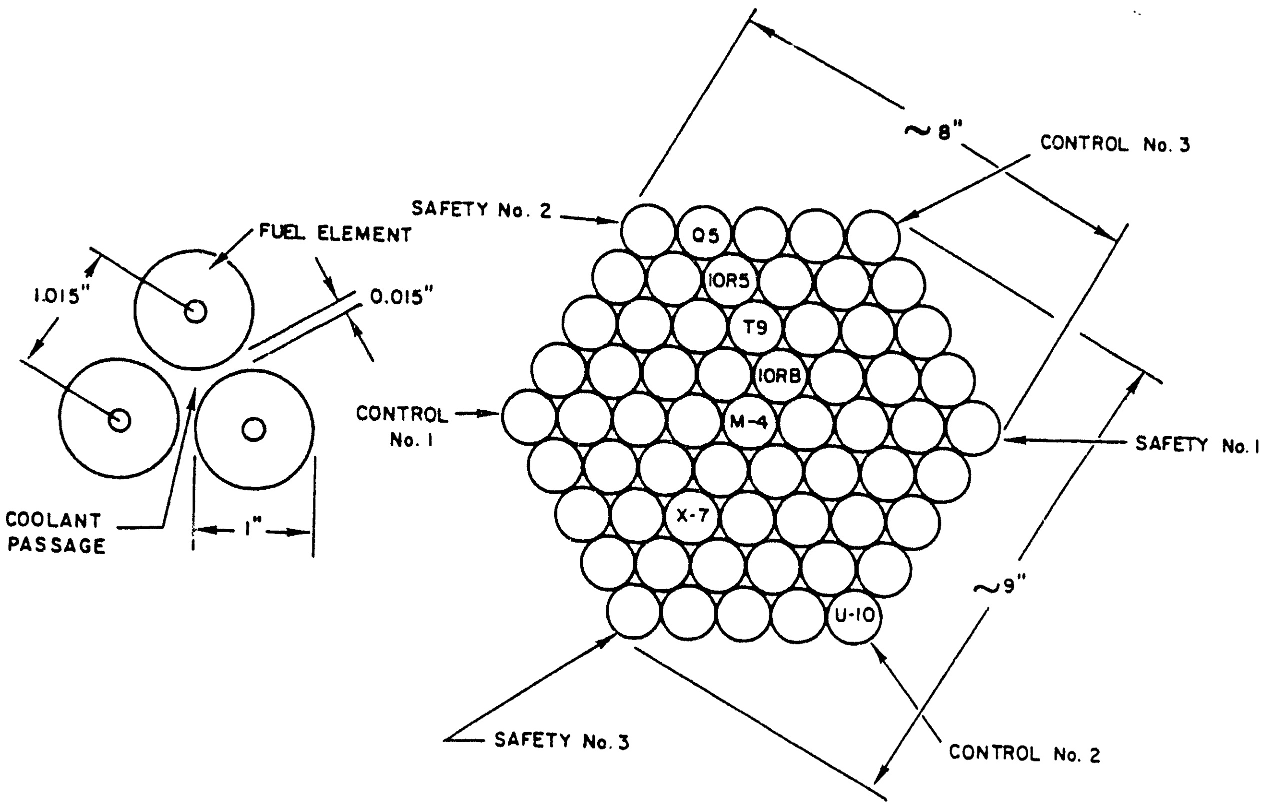
Appendix A: Additional Element and Core Data

Figure 2: SER Fuel Element Schematic



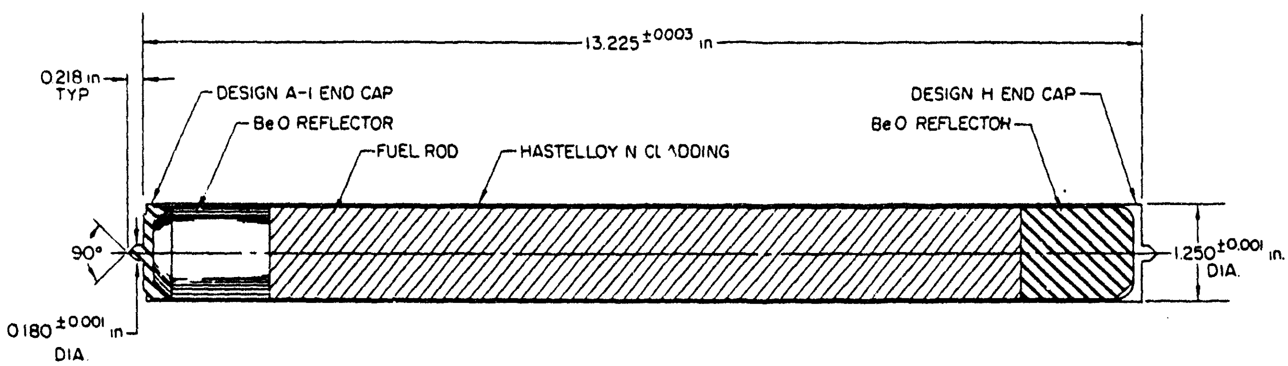
Miller, J.R., "Postirradiation Evaluation of SER Fuel Elements," NAA-SR-8090, p. 10, May 1, 1963.

Figure 3: SER Core Loading



Miller, J.R., "Postirradiation Evaluation of SER Fuel Elements," NAA-SR-8090, p. 14, May 1, 1963.

Figure 4: S2DR Fuel Element Schematic



Dennison, W.F., and Jakobowski, T.S, "Assembly of S-2 DR Fuel Elements," NAA-SR-7048, p. 7, December 15, 1962.

Figure 5: S2DR Core Loading

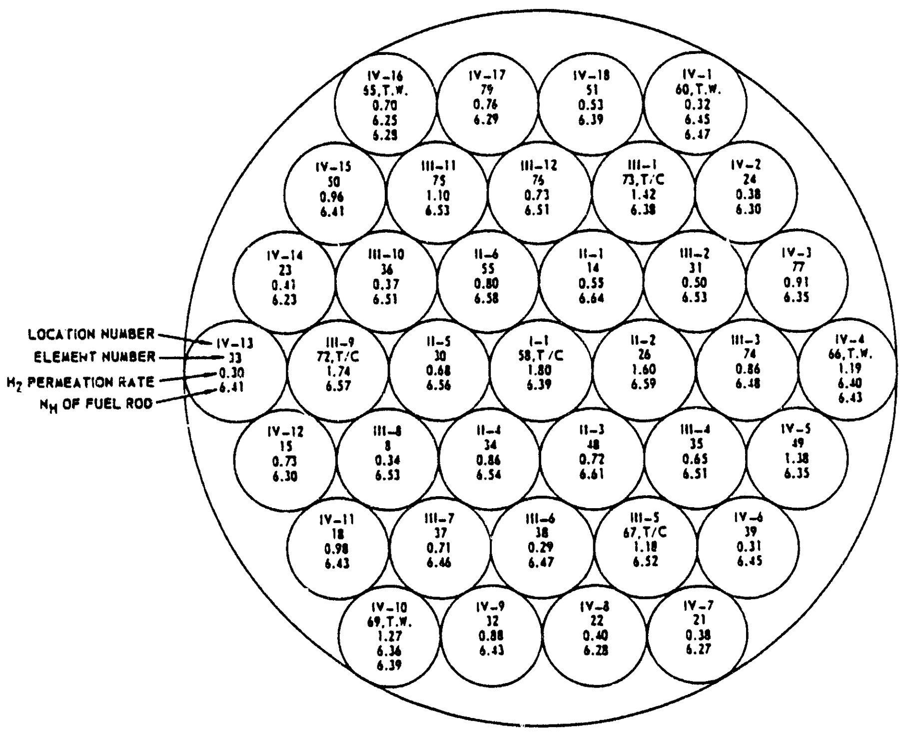


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Figure 6: S2DR Cross Section

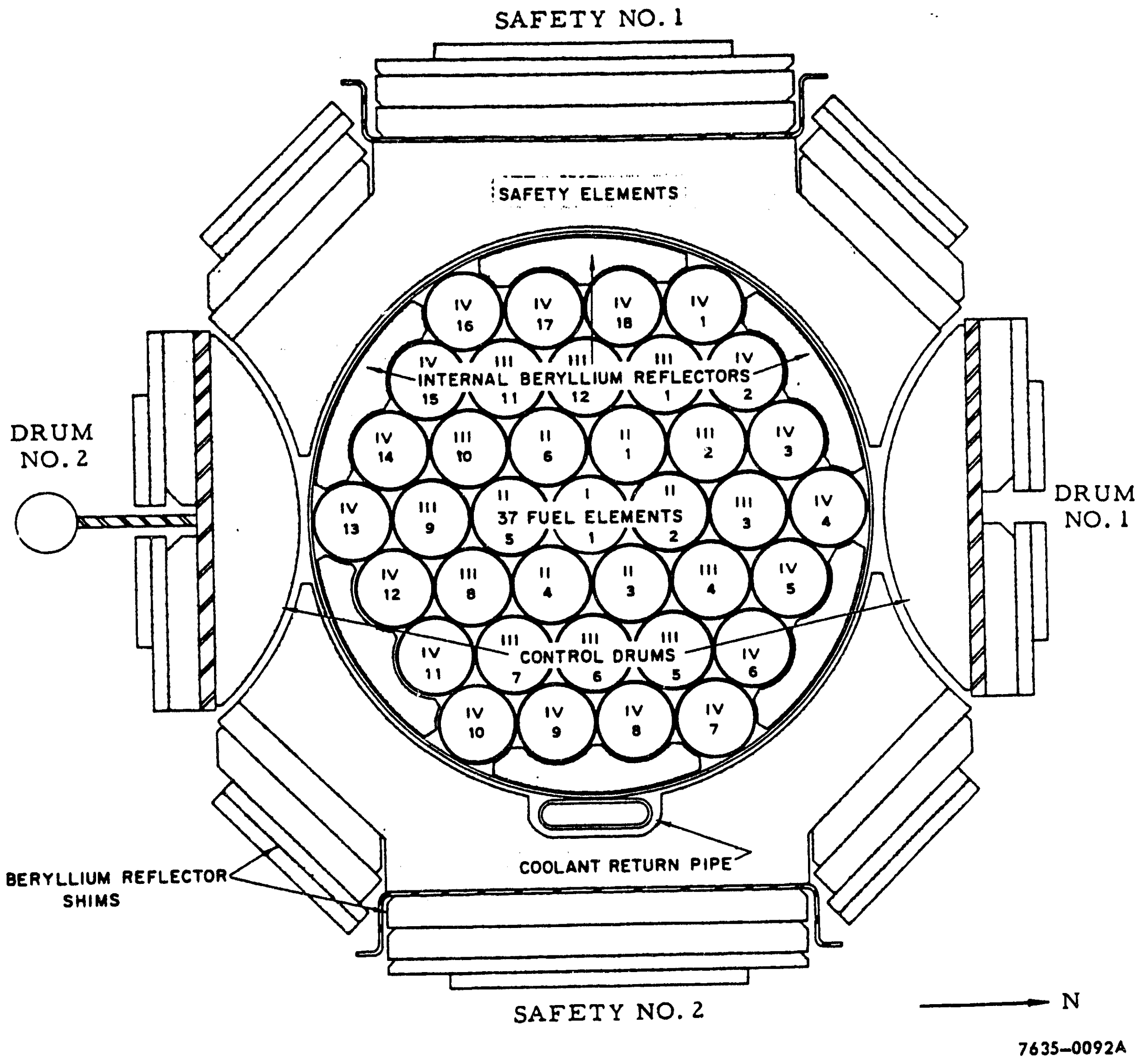

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Table 2: S2DR Fuel Elements Produced, Components, and Data

Element Number	Fuel Rod Number	N_H	Leak Rate at 1200°F (cc/hr)	TIR (10^{-3} in.)	A-1 Cap Number	H Cap Number	Tube Number	BeO Reflectors Number	Miscellaneous Comments
5	516-7	6.41	-	12	37	36	18-8	13-32,13-34	Dry Critical Element
8	515-4	6.53	0.34	9.5	15	47	20-1	13-35,36	
10	517-4	6.64	-	12	43	53	23-2	46,47	Dry Critical Element
11	516-6	6.73	-	11.5	31	66	6-5	48,49	Dry Critical Element
12	516-5	6.79	-	13	36	64	14-7	44,45	Dry Critical Element
14	519-2	6.64	0.55	15.5	17	26	14-4	52,53	
15	515-1	6.30	0.73	9.5	28	35	19-4	50,51	
17	517-2	6.51	1.74	12	41	40	25-3	58,59	Not used in the core
18	517-6	6.43	0.98	17.5	48	58	22-2	60,61	
19	519-3	6.54	1.80	13	32	32	6-2	56,57	Not used in the core
21	518-6	6.27	0.38	11.5	46	20	9-5	62,63	
22	515-3	6.28	0.40	13.5	47	55	23-1	64,65	
23	517-7	6.23	0.41	14	22	65	6-4	66,67	
24	519-1	6.30	0.38	9.5	45	49	11-6	68,69	
26	515-5	6.59	1.60	10	21	56	11-2	42,43	
30	517-3	6.56	0.68	17	52	67	9-1	79,82	
31	517-5	6.53	0.50	8.5	61	84	2-1	85,86	
32	517-1	6.43	0.88	8	51	62	14-8	89,90	
33	520-5	6.41	0.30	16.5	53	70	16-4	91,92	
34	518-2	6.54	0.86	3	54	68	19-2	93,94	
35	519-7	6.51	0.65	9.5	60	79	7-6	97,98	
36	518-3	6.51	0.37	14	59	71	9-4	95,96	
37	527-3	6.46	0.71	20.5	64	69	15-2	99,100	
38	518-1	6.47	0.29	11.5	65	73	17-5	101,102	
39	520-2	6.45	0.31	5.5	66	83	14-1	103,104	
41	520-4	6.59	-	14	33	52	11-3	72,74	Dry Critical Element
42	516-4	6.58	-	10	55	86	13-1	20,21	Dry Critical Element
43	520-6	6.50	-	6.5	94	185	236	80,81	Dry Critical Element
44	515-2	6.52	-	16.5	95	156	209	111,112	Dry Critical Element
45	518-5	6.37	-	13	96	177	234	113,114	Dry Critical Element
47	519-5	6.60	2.00	8.5	71	80	6-3	77,78	Not used in the core
48	515-6	6.61	0.72	11	74	34	24-1	54,55	
49	527-1	6.35	1.38	7	75	87	11-5	70,71	
50	519-6	6.41	0.96	9	78	54	23-3	18,19	
51	520-7	6.39	0.53	14.5	88	88	14-5	13-28,13-29	
54	509-2	6.63	1.20	12	83	48	25-2	105,107	Not used in the core
55	519-4	6.58	0.80	11.5	87	72	16-7	75,76	
58	516-2	6.39	1.80	10	93	4-4	16-5	38,13-30	Center Thermocouple*
60	520-3	6.45	0.32	13	101	186	232	119,120	0.011 in. Cladding, Fuel rod has thermocouple hole
65	511-4	6.25	0.70	11	105	67	220	127,128	0.011 in. Cladding
66	511-6	6.40	1.19	10	109	173	218	129,130	0.011 in. Cladding
67	516-3	6.52	1.18	7	90	12-12	-	109,123	Outer Thermocouple*
69	513-6	6.36	1.27	8	113	184	233	117,118	0.011 in. Cladding
72	509-3	6.57	1.74	8.5	92	6	4-4	22,26	Outer Thermocouple*
73	512-6	6.38	1.42	13.5	82	198	-	41,126	Outer Thermocouple*
74	510-4	6.48	0.86	18	77	41	18-1	83,87	
75	510-5	6.53	1.10	8	79	90	22-1	131,132	
76	526-1	6.51	0.73	13	91	81	15-1	134,135	Fuel rod has thermo-couple hole
77	513-5	6.35	0.91	3	89	207	-	115,116	
79	511-3	6.29	0.76	8	132	211	-	124,125	Fuel rod has thermo-couple hole
80	516-1	6.52	1.50	4	14	202	-	122,123	Fuel rod has thermo-couple hole, Not used in the core

*Refers to location within the core geometry

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Figure 7: 10FS-3 Fuel Element Schematic

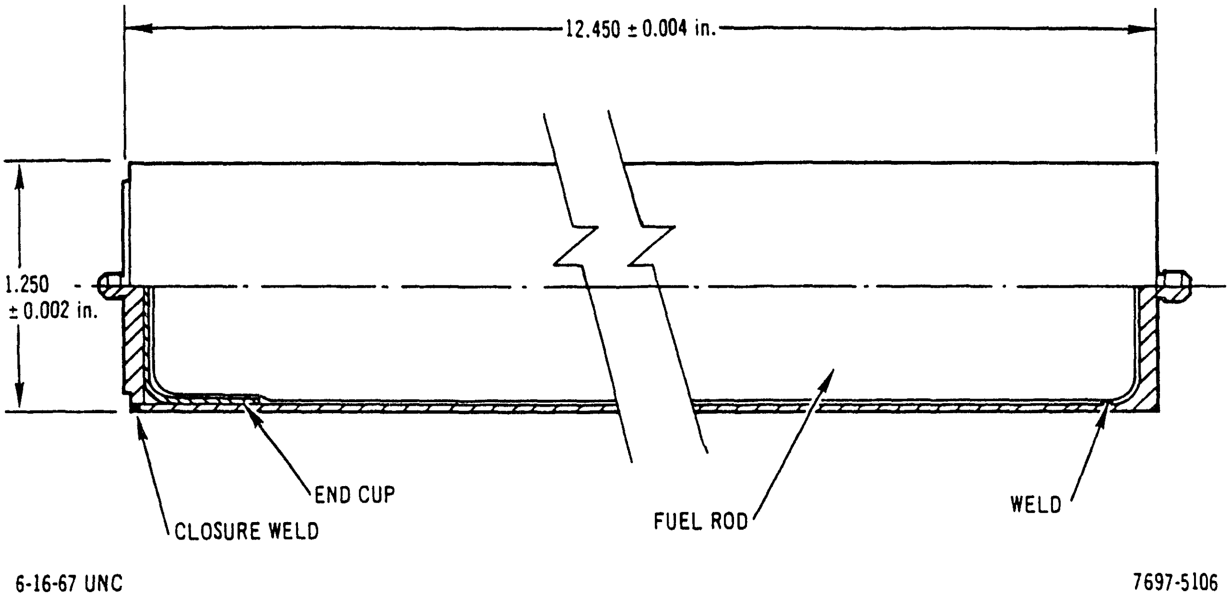

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Figure 8: 10FS-3 Core Loading

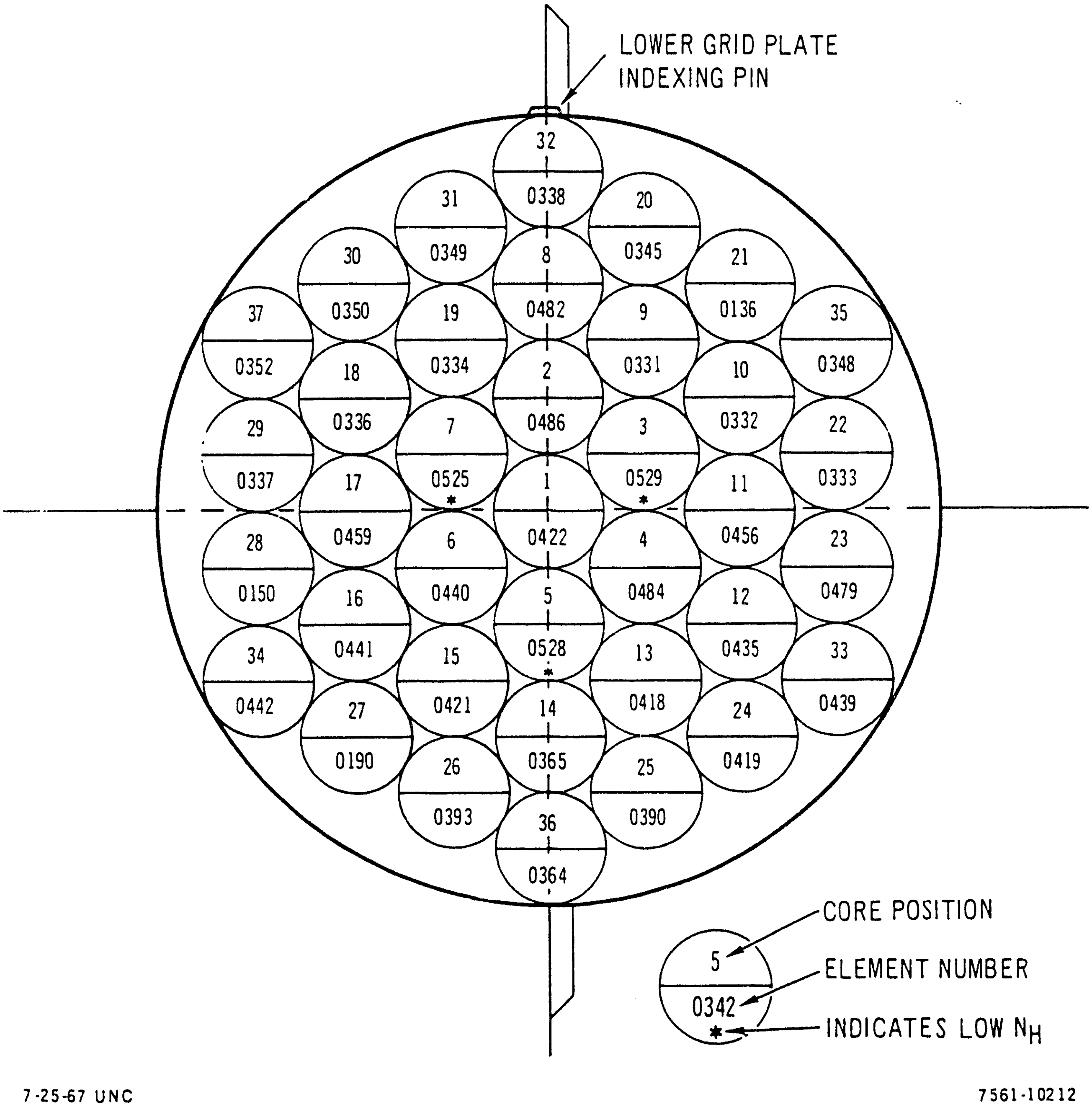

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Figure 9: S8ER Fuel Element Schematic

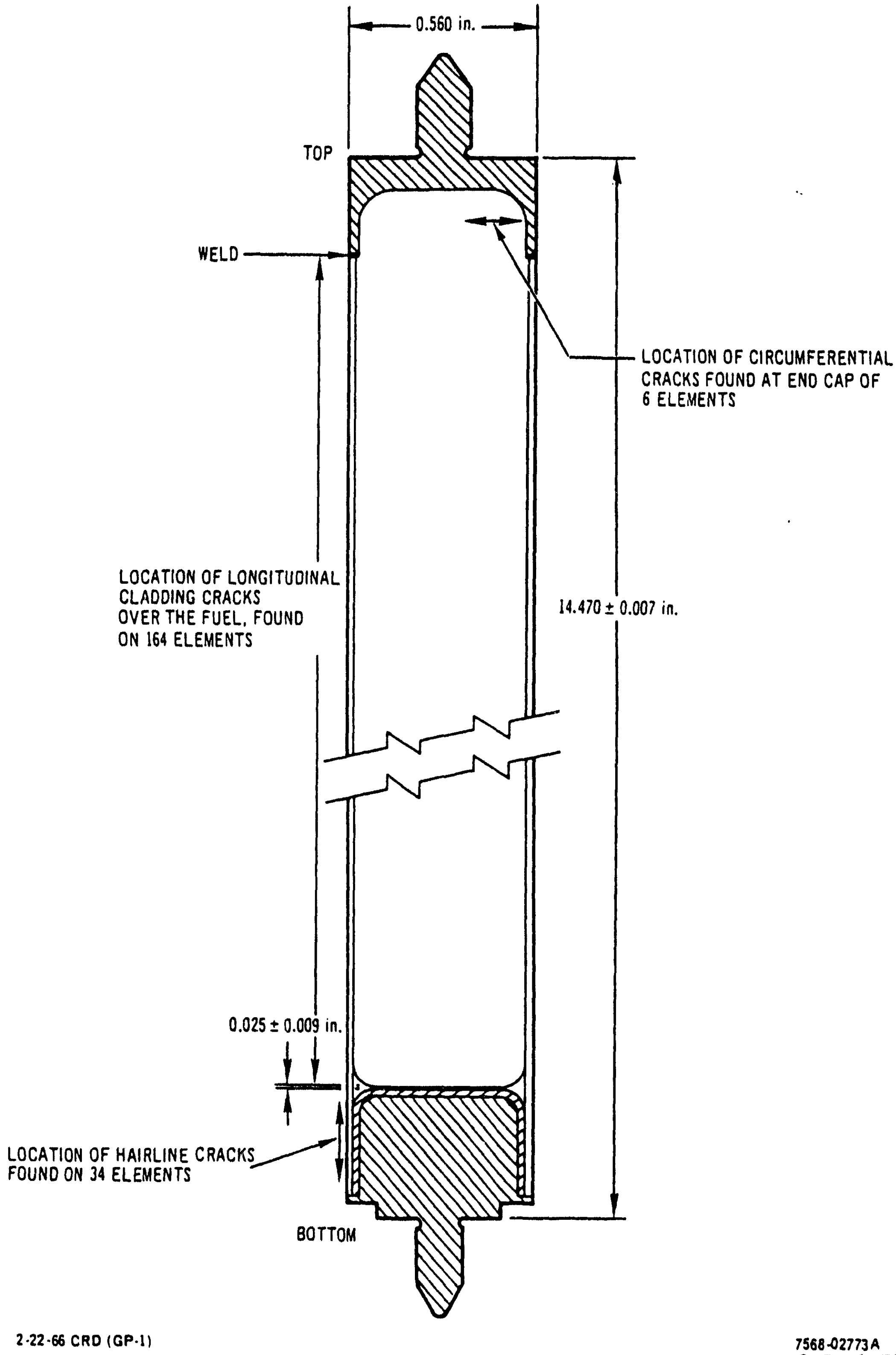

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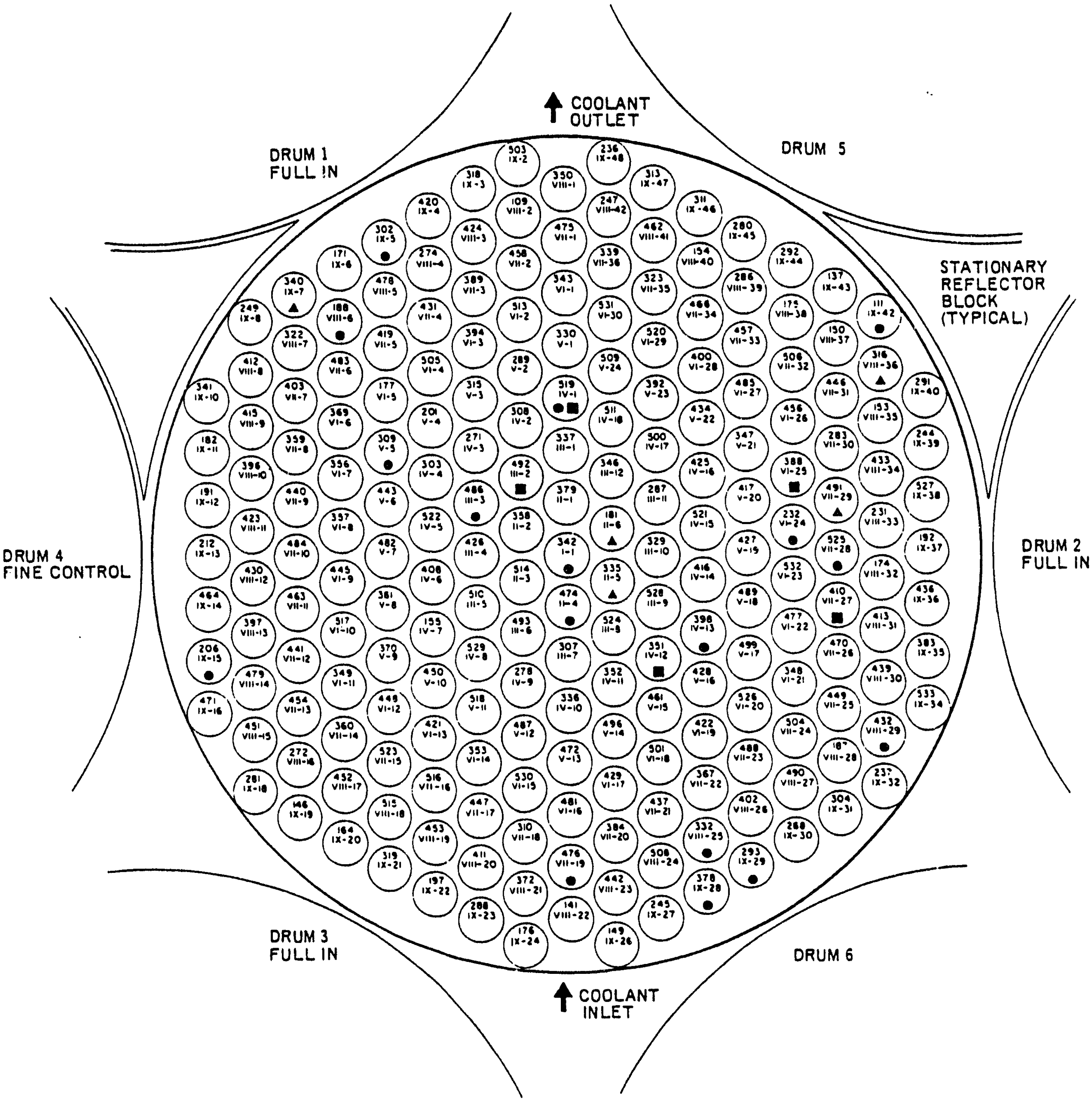
Figure 10: S8ER Core Loading



● DETAILED DESTRUCTIVE EXAMINATION
▲ TENSILE TESTS
■ INTERFACE STUDIES

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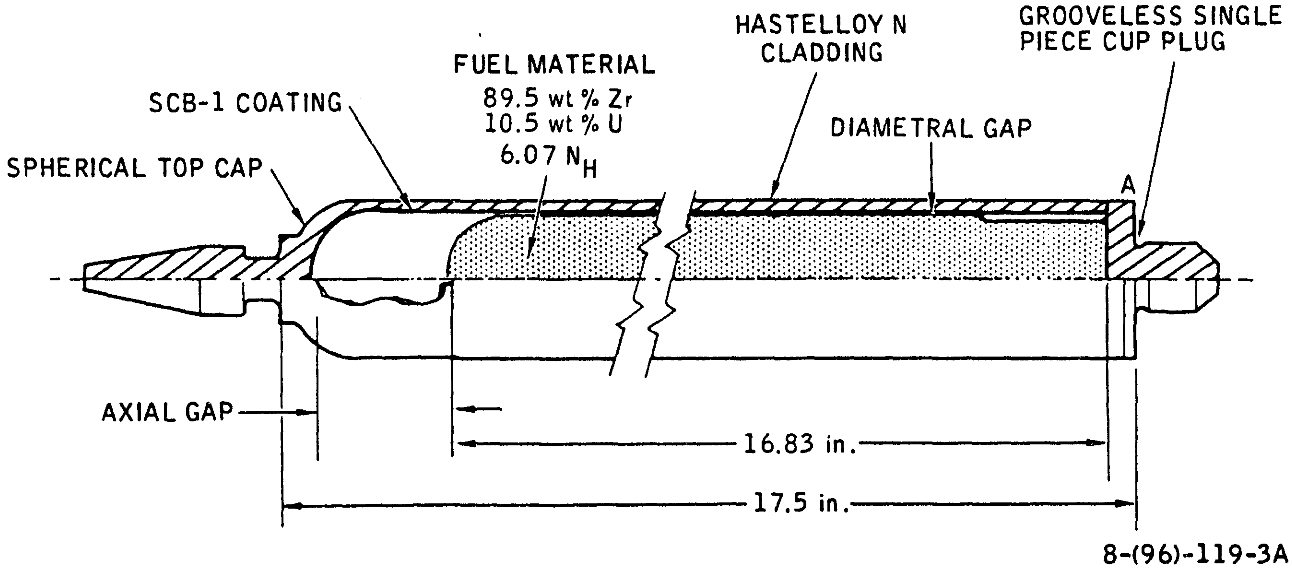
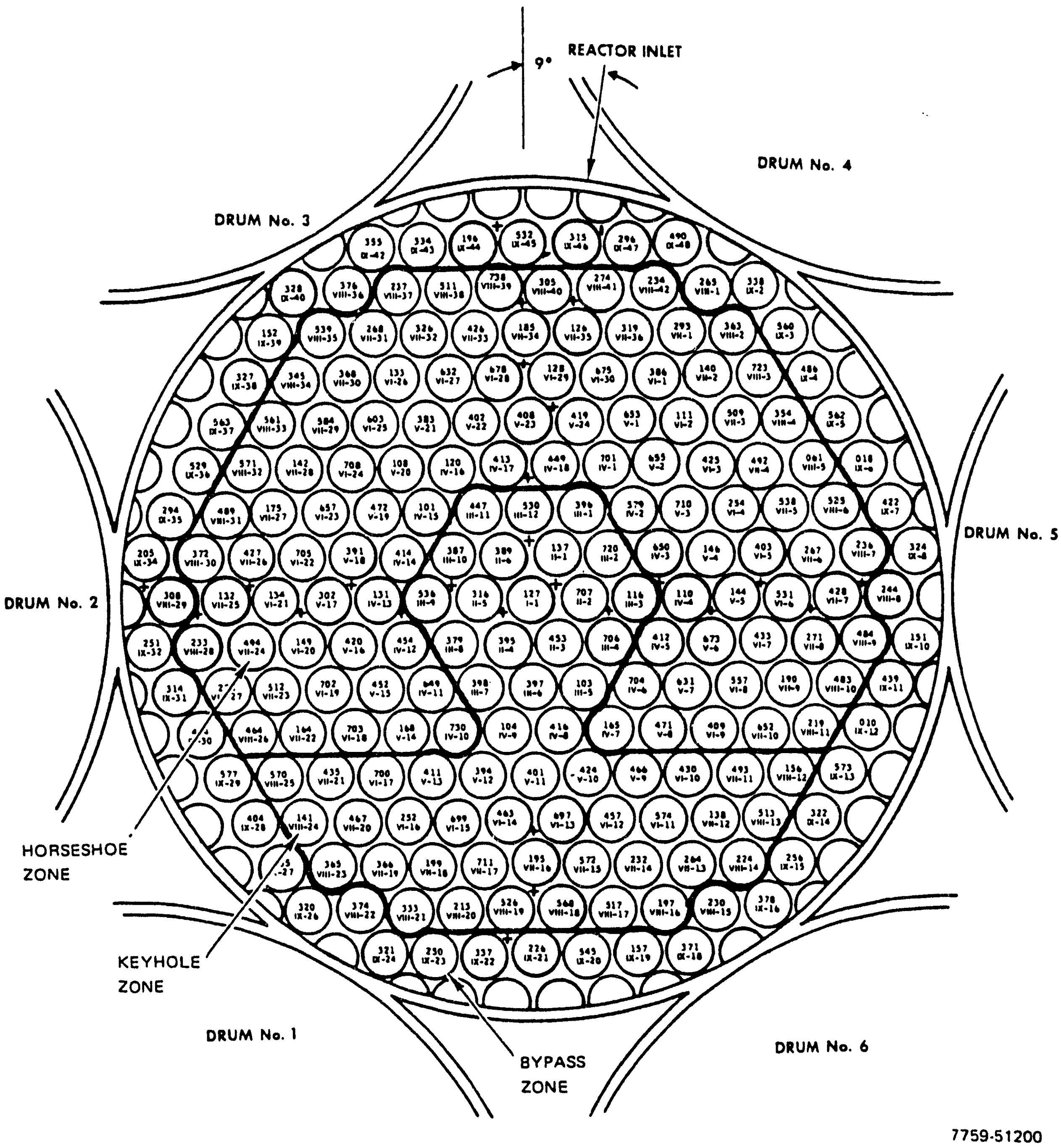
Olson, P.S., Miller, K.J., and Donovan, E.J., "Postoperation Evaluation of Fuel Elements from the SNAP 8 Experimental Reactor," NAA-SR-12029, p. 50, September 15, 1967.

Figure 11: S8DR Fuel Element Schematic



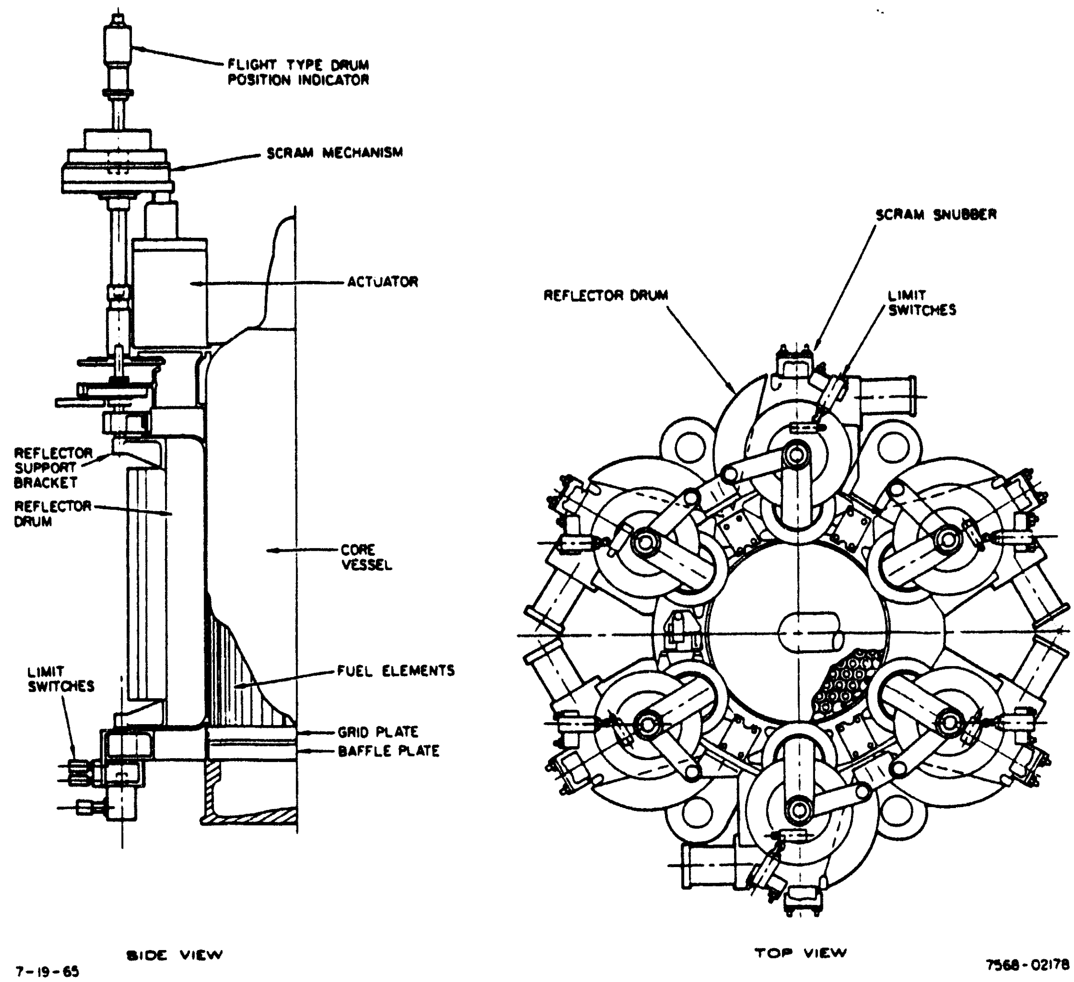
Swenson, L.D., "SNAP 8 Development Reactor Nuclear Analysis," AI-AEC-12864, p. 14, October 31, 1969.

Figure 12: S8DR Core Loading



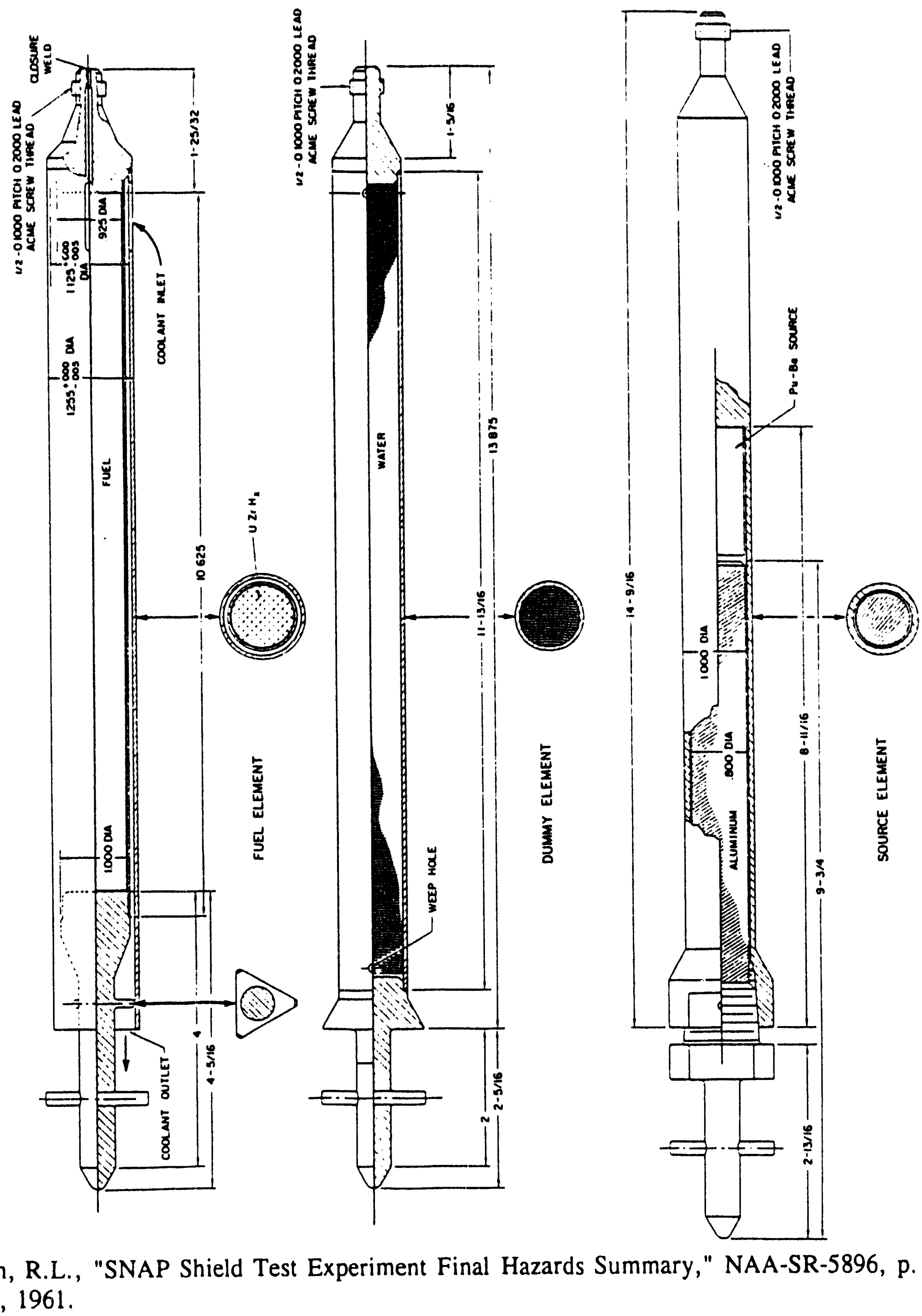
Lillie, A.H. and Rooney, V.L., Jr., "The SNAP 8 Developmental Reactor (S8DR) Post-Test Examination," AI-AEC-13003, p. 52, June 30, 1971.

Figure 13: S8DR Cross Section



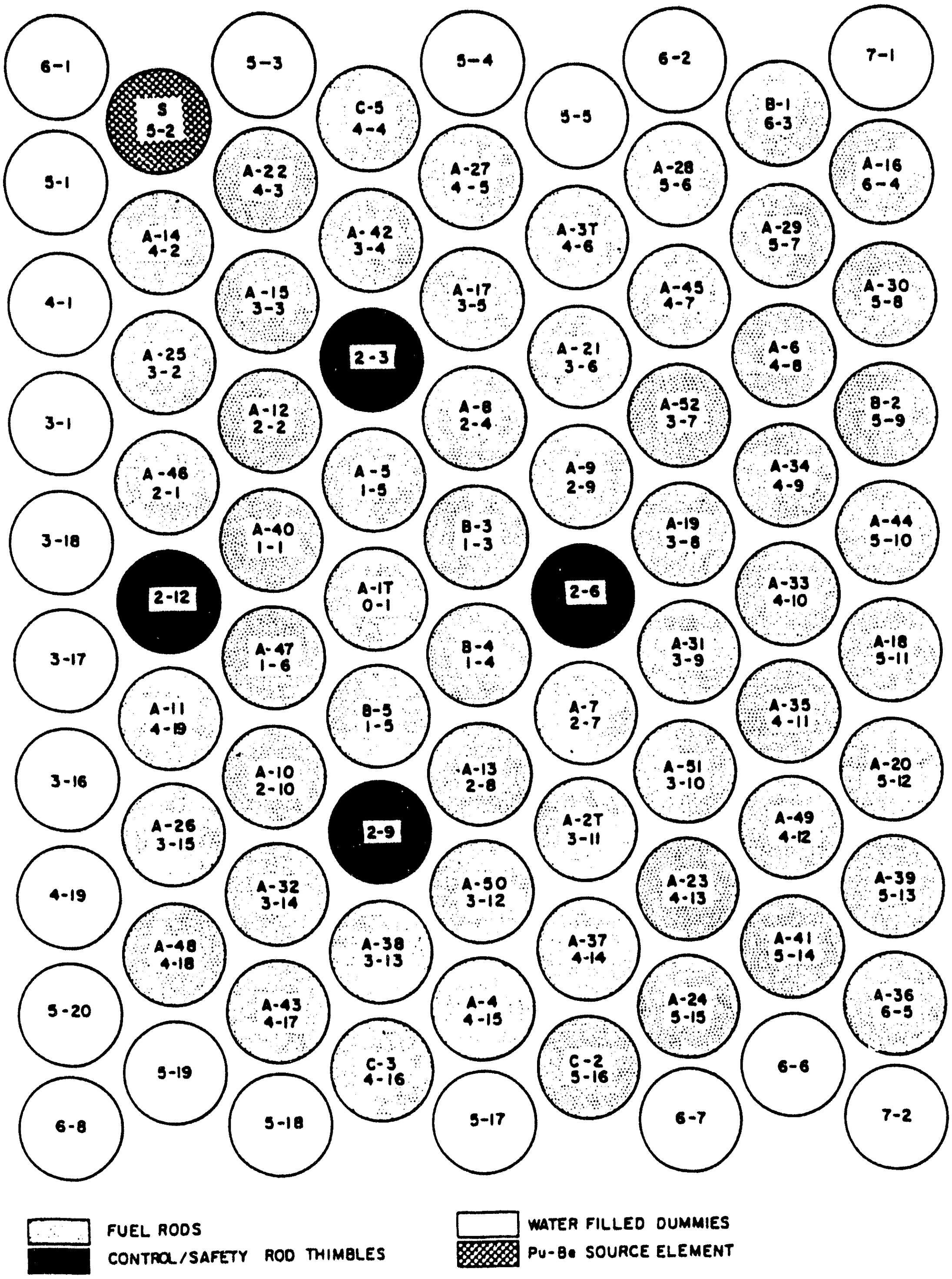
Lillie, A.H. and Rooney, V.L., Jr., "The SNAP 8 Developmental Reactor (S8DR) Post-Test Examination," AI-AEC-13003, p. 16, June 30, 1971.

Figure 14: STF Fuel Element Schematic



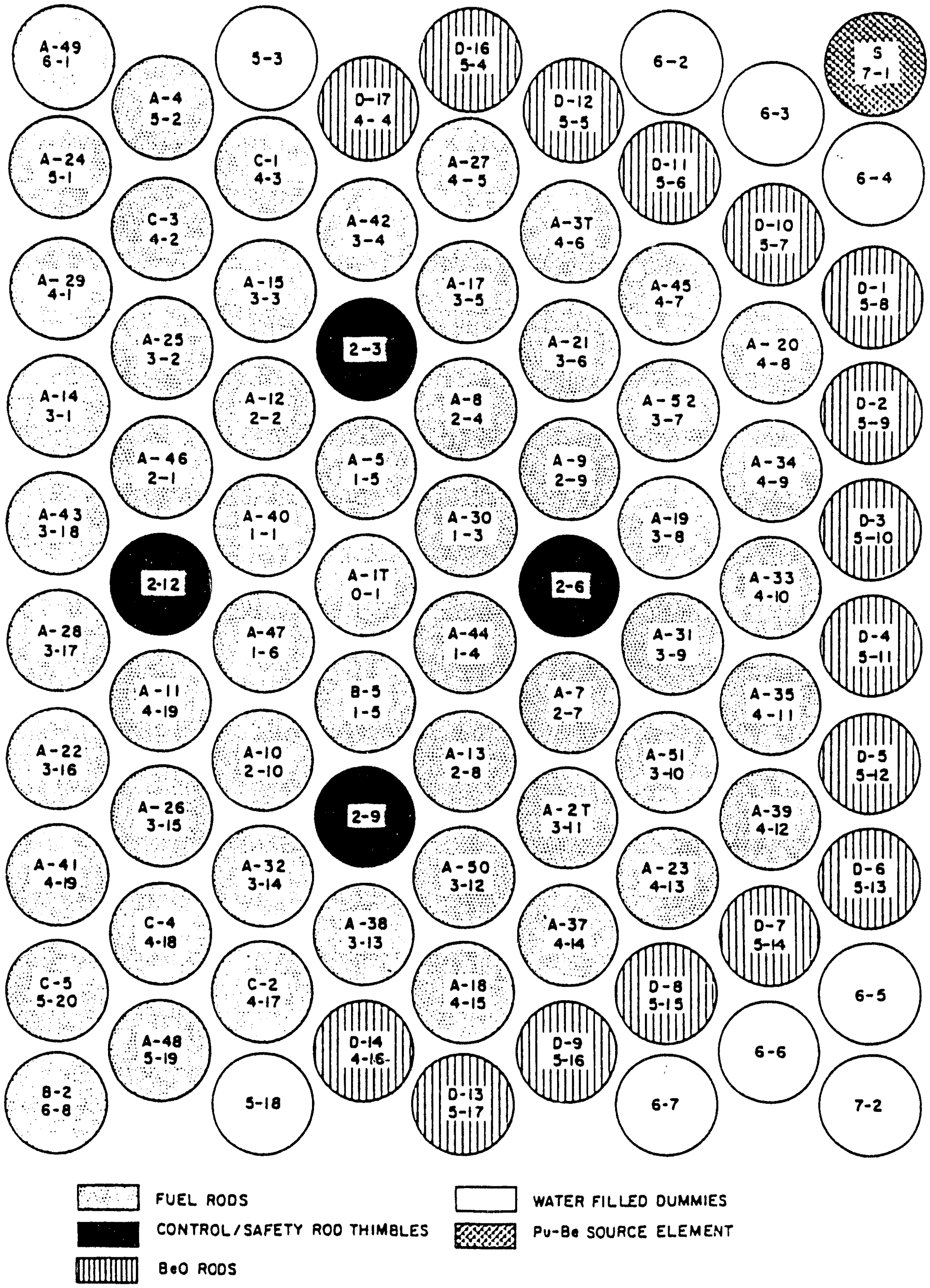
Tomlinson, R.L., "SNAP Shield Test Experiment Final Hazards Summary," NAA-SR-5896, p. 48, March 17, 1961.

Figure 15: STF Initial Core Loading



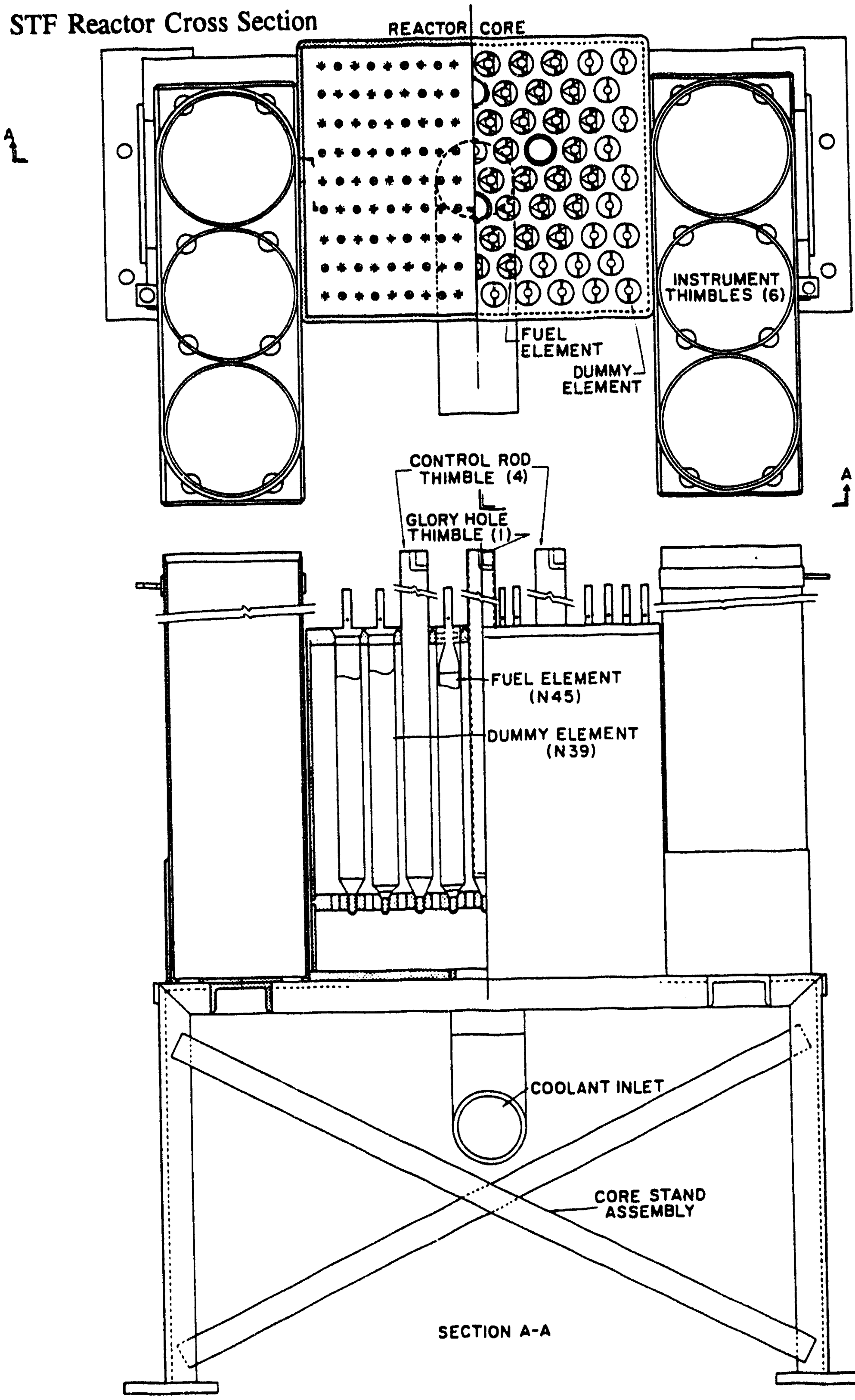
Tomlinson, R.L., Johnson, R.P., and Wogulis, S.G., "SNAP Shield Test Experiment Reactor Physics Tests," NAA-SR-7368, p. 4, July 15, 1962.

Figure 16: STF Revised Core Loading



Tomlinson, R.L., Johnson, R.P., and Wogulis, S.G., "SNAP Shield Test Experiment Reactor Physics Tests," NAA-SR-7368, p. 5, July 15, 1962.

Figure 17: STF Reactor Cross Section



Tomlinson, R.L., "SNAP Shield Test Experiment Final Hazards Summary," NAA-SR-5896, p. 46, March 17, 1961.

Appendix B: Burnup Data

Burnup Data Listed in References

Peak Values:

SER
0.02 metal atom percent.[1]
0.016 m.a.% based on the gamma scan profiles of six elements. The first analysis of one of the elements was off by an order of magnitude; these burnup determinations are only useful as estimates.[2]
0.02 m.a. by design.[3]

S2DR
0.02 metal atom percent.[4]
0.02 m.a.% by design.[3]
0.021 m.a.% by design.[5]

10FS-3
0.023 metal atom percent based on the analysis of one element.[6]
0.025 m.a.% by design.[3]
0.03 m.a.% by design.[5]

S8ER
0.26 metal atom percent based on the average gamma scan profile across 19 elements.[7]
0.25 m.a.% by design.[3,5]

S8DR
0.23 metal atom percent by design.[5]

STF
no peak burnup values available

Average or Nominal Values:

SER (taken as 0.010 metal atom percent)
0.01 m.a.%.[1]
0.010 m.a.% based on total thermal energy released.[2]
<1% (224.65 Mw(t) hrs.).[8]

S2DR (taken as 0.025 metal atom percent)
0.01 m.a.%.[4]
<1% (272.9 Mw(t) hrs.).[8]
0.025 m.a.% based on total thermal energy released.[9]
0.027 m.a.% based on analysis of one element, ± 10% due to uncertainty in the fission yield of Ce^{144} (assumed at 5.3%).[9]
0.01 m.a.% by design.[5]

10FS-3 (taken as 0.023 metal atom percent)
0.023 m.a.%.[10]
0.0227 m.a.% based on the analysis of one element.[6]
0.0'5 m.a.% by design.[5]

S8ER (taken as 0.20 metal atom percent)
0.20 m.a.%.[8]
0.154 m.a.% based on the analysis of two elements.[7]
0.14 m.a.% by design.[5]

S8DR (taken as 0.13 metal atom percent)
0.13 m.a.% by design.[5]

STF (taken as 0.005 metal atom percent)
46.138 Mw(t) hrs.[8]

[1]"Reactor Fuel Data Questionnaire: SNAP Experimental Reactor," September 25, 1961, SNAP and AI Fuel Receipt Criteria, Idaho Chemical Processing Plant.

[2]Miller, J.R., "Postirradiation Evaluation of SER Fuel Elements," NAA-SR-8090, pp. 20 & 21, May 1, 1963.

[3]Birney, K.R., "An Empirical Study of SNAP Reactor Fuel Irradiation Behavior," NAA-SR-12284, p. 7, August 10, 1967.

[4]"Reactor Fuel Data Questionnaire: SNAP-2 Developmental Reactor," September 25, 1961, SNAP and AI Fuel Receipt Criteria, Idaho Chemical Processing Plant.

[5]Lillie, A.F., McClelland, D.T., Roberts, W.J., and Walter, J.H., "Zirconium Hydride Fuel Element Performance Characteristics," AI-AEC-13084, p. 8, June 19, 1973.

[6]Golding, T.A., "Post-Operation Evaluation of Fuel Elements from the SNAP 10 Flight System 3 Reactor," NAA-SR-12031, p. 32, September 15, 1967.

[7]Olson, P.S., Miller, K.J., and Donovan, E.J., "Postoperation Evaluation of Fuel Elements from the SNAP 8 Experimental Reactor," NAA-SR-12029, p. 37, September 15, 1967.

[8]Martin, W.G., "Shipping/Recovery of SNAP Irradiated Fuel," Atomics International, letter 68AT-1419, to N. Rigstad, Idaho Nuclear Corporation, March 19, 1968, SNAP and AI Fuel Receipt Criteria, Idaho Chemical Processing Plant.

[9]Olson, P.S, "Evaluation of Fuel Elements from SNAP 2 Development Reactor Core," NAA-SR-9648, p. 33, January 15, 1965.

[10]Rigstad, N.R., "Transfer of 10FS-3 SNAP Fuel Core From Atomics International," Idaho Nuclear Corporation, letter Rig-8-67 to S.F. Fairbourne and M. Young, April 26, 1967, SNAP and AI Fuel Receipt Criteria, Idaho Chemical Processing Plant.

Appendix C: SNAP and AI Fuel Can Contents and Storage Locations

The Fuel Receipt Criteria documents are a collection of correspondence, drawings, criticality safety information, and basic data required for the acceptance of the spent fuel at the ICPP at the time of shipment. Table 3: SNAP and AI Spent Fuel in Storage at ICPP was developed by correlation and cross-verification of the information in the FRC documentation and in the other available references. More stringent requirements have evolved for the shipment of spent fuel, and emphasis has shifted from reprocessing to storage. The quality and quantity of information available varies for the different reactors, and the examples given on the first page of the table are intended to illustrate the variations in format for each reactor. The core loading figures in Appendix A can be used to establish additional background information on the fuel elements identified in Table 3.

Comparison of weights of uranium loading given for can contents to the weights of uranium from sums of loadings of elements and sums of prior shipper's cans contents shows good correlation. The weights of uranium loading given for can contents exactly equal the sums of loading where given for prior shipper's cans contents. Can SN-2 is the only discrepancy of greater than two grams based on the available element loading information. The discrepancy in SN-2 (20 grams of U235, 22 grams of U, and 229 grams of UZrH) is probably due to destructive post-irradiation examination of S2DR elements 50 and 39. Presumably the original weights are those listed on the AI shipping documents, and the teletyped shipping notification and subsequent FRC documents give updated values based on weights recorded after destructive examination where some mass seems to have been lost.

Table 3: SNAP and AI Spent Fuel in Storage at ICPP

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position) EXAMPLES	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-# (CAN-SF-91-#)	Basin	Position prior to recanning (new can location)	# of (descriptor used at time of decladding) S2DR elements # from Shipper's Can # (weight of material from that can): (fuel rod #) element #, core position # (weight of material from that element)	Weights of U loading, can contents Weights of U loading from sum of loading in elements (where possible)			Specific gravity	Date	Bucket #
SN-# (CAN-SF-91-#)	Basin	Position prior to recanning (new can location)	# of (descriptor) SER (or TRIGA) elements # from Shipper's Can # (weight of material from that can): element #, element #, element #, ...	Weights of U loading, can contents			Specific gravity	Date	Bucket #
SN-# (CAN-SF-91-#)	Basin	Position prior to recanning (new can location)	# of (descriptor) STF elements # from Shipper's Can # (weight of material from that can): element # (c1: core 1 position #, c2: core 2 position #), element # (c1&c2: position # which was the same for both cores)	Weights of U loading, can contents			Specific gravity	Date	Bucket #
SN-# (CAN-SF-91-#)	Basin	Position prior to recanning (new can location)	# of (descriptor) 10SF-3 or S8ER elements # from Shipper's Can # (weight of material from that can): element # (core position #), element # (core position #), ...	Weights of U loading, can contents			Specific gravity	Date	Bucket #
AI-# (CAN-SF-90-#)	Basin	Position prior to recanning (new can location)	S8DR fuel (descriptor), # of elements from Shipper's Can #: element # (core position #) fuel rod # (weight of material from that element)	Weights of U loading, can contents Weights of U loading from sum of loading in elements (where possible)			Specific gravity	Date	Bucket #
AI-# (CAN-SF-90-#)	Basin	Position prior to recanning (new can location)	S8ER fuel (descriptor), # of elements from Shipper's Can #: element # (core position #) fuel rod # (weight of material from that element)	Weights of U loading, can contents Weights of U loading from sum of loading in elements (where possible)			Specific gravity	Date	Bucket #

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-1	middle	32-G, yoke 950	12 complete S2DR elements	1260	1356	13697	2.1	Jul-66	1
(CAN-SF-91-17)		(38-F, yoke 906)	6 from S2DR 1 (6850g UZrH, 630g U235, 678g U, 6172g ZrH):	1260	1356	13696			
			(527-3) 37, III-7 (1143g UZrH, 105g U235, 113g U, 1030g ZrH)						
			(515-4) 8, III-8 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(516-2) 58, I-1 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(520-5) 33, IV-13 (1142g UZrH, 105g U235, 113g U, 1029g ZrH)						
			(527-1) 49, IV-5 (1142g UZrH, 105g U235, 113g U, 1029g ZrH)						
			(517-6) 18, IV-11 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			6 from S2DR 2 (6847g UZrH, 630g U235, 678g U, 6169g ZrH):						
			(515-6) 48, II-3 (1142g UZrH, 105g U235, 113g U, 1029g ZrH)						
			(515-5) 26, II-2 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(515-3) 22, IV-8 (1142g UZrH, 105g U235, 113g U, 1029g ZrH)						
			(517-3) 30, II-5 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(518-2) 34, II-4 (1140g UZrH, 105g U235, 113g U, 1027g ZrH)						
			(518-1) 38, III-6 (1140g UZrH, 105g U235, 113g U, 1027g ZrH)						
SN-2	middle	32-F, yoke 951	8 complete S2DR elements	822	884	8920	2.2	Jul-66	2
(CAN-SF-91-18)		(38-H, yoke 856)	2 from S2DR 4 (2055g UZrH, 190g U235, 204g U, 1851g ZrH):	842	906	9149			
			(519-6) 50, IV-15 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(520-2) 39, IV-6 (1143g UZrH, 105g U235, 113g U, 1030g ZrH)						
			6 from S2DR 5 (6865g UZrH, 632g U235, 680g U, 6185g ZrH):						
			(515-1) 15, IV-12 (1143g UZrH, 105g U235, 113g U, 1030g ZrH)						
			(519-7) 35, III-4 (1142g UZrH, 105g U235, 113g U, 1029g ZrH)						
			(518-6) 21, IV-7 (1142g UZrH, 105g U235, 113g U, 1029g ZrH)						
			(517-1) 32, IV-9 (1142g UZrH, 105g U235, 113g U, 1029g ZrH)						
			(516-3) 67, III-5 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(513-6) 69, IV-10 (1155g UZrH, 107g U235, 115g U, 1042g ZrH)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

Al (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-3	south	rack 901-2, F-3	12 complete S2DR elements	1264	1360	13718	2.1	Aug-66	3
(CAN-SF-91-11)		(RK-SF-900-46 port 11)	6 from S2DR 6 (6863g UZrH, 632g U235, 680g U, 6183g ZrH):	1262	1358	13718			
			(510-4) 74, III-3 (1140g UZrH, 105g U235, 113g U, 1027g ZrH)						
			(509-3) 72, III-9 (1136g UZrH, 105g U235, 113g U, 1023g ZrH)						
			(519-2) 14, II-1 (1142g UZrH, 105g U235, 113g U, 1029g ZrH)						
			(517-5) 31, III-2 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(513-5) 77, IV-3 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(511-6) 66, IV-4 (1155g UZrH, 105g U235, 113g U, 1042g ZrH)						
			6 from S2DR 7 (6855g UZrH, 632g U235, 680g U, 6175g ZrH):						
			(520-7) 51, IV -18 (1141g UZrH, 105g U235, 113g U, 1028g ZrH)						
			(520-3) 60, IV-1 (1153g UZrH, 106g U235, 114g U, 1040g ZrH)						
			(511-4) 65, IV-16 (1153g UZrH, 106g U235, 114g U, 1040g ZrH)						
			(512-6) 73, III-1 (1137g UZrH, 105g U235, 113g U, 1024g ZrH)						
			(511-3) 79, IV-17 (1139g UZrH, 105g U235, 113g U, 1026g ZrH)						
			(566-1) 76, III-12 (1140g UZrH, 105g U235, 113g U, 1027g ZrH)						
SN-4	south	rack 901-2, F-6	18 complete SER elements	835	889	13017	2.0	Aug-66	4
(CAN-SF-91-14)		(RK-SF-900-46 port 14)	from SER 2 (13017g UZrH, 835g U235, 889g U, 12128g ZrH):						
			5R9, 9R5, M6, Y6, Q4, Q6, Y7, Z1, T8,						
			11R7, 9R10, 5R2, R4, Q3, Q2, 5R3, 10R10, 6R4						
SN-5	south	rack 901-2, F-7	18 complete SER elements	830	884	12998	2.0	Aug-66	4
(CAN-SF-91-4)		(RK-SF-900-46 port 4)	from SER 1 (12998g UZrH, 830g U235, 884g U, 12114g ZrH):						
			10R7, 6R3, M2, R3, Z7, Q5, W6, 9R9, 11R3,						
			T2, R1, 5R8, X7, W2, W1, Q1, 10R9, 9R3						
SN-6		does not exist	intended to hold another 18 SER elements, but these ended up in SN-20						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-7 (CAN-SF-91-9)	south	rack 901-2, F-4 (RK-SF-900-46 port 9)	18 complete STF elements 6 from STF 1 (3873g UZrH, 251g U235, 269g U, 3604g ZrH): A51 (c1&c2, 3-10), A31 (c1&c2, 3-9), A19 (c1&c2, 3-8), A52 (c1&c2, 3-7), A45 (c1&c2, 4-7), A37 (c1&c2, 4-14) 6 from STF 2 (3895g UZrH, 255g U235, 273g U, 3622g ZrH): A20 (c1: 5-12, c2: 4-8), A33 (c1&c2: 4-10), A34(c1&c2: 4-9), A35 (c1&c2: 4-11), A39 (c1: 5-13, c2: 4-12), A44 (c1: 5-10, c2: 1-4) 6 from STF 3 (3873g UZrH, 251g U235, 275g U, 3598g ZrH): A1T (c1&c2: 0-1), A16 (c1: 6-4), A2T (c1&c2: 3-11), A7 (c1&c2: 2-7), A13 (c1&c2: 2-8), A18 (c1: 5-11, c2: 4-15)	757	817	11641	1.8	Aug-66	6
SN-8 (CAN-SF-91-2)	south	rack 901-3, D-1 (RK-SF-900-46 port 2)	18 complete STF elements 6 from STF 4 (3916g UZrH, 272g U235, 292g U, 3624g ZrH): C1 (c2: 4-3), B3 (c1: 1-3), A38 (c1&c2: 3-13), A9 (c1&c2: 2-9), A21 (c1&c2: 3-6), A10 (c1&c2: 2-10) 6 from STF 5 (3848g UZrH, 250g U235, 268g U, 3580g ZrH): A50 (c1&c2: 3-12), A24 (c1: 5-15, c2: 5-1), A23 (c1&c2: 4-13), A30 (c1: 5-8, c2: 1-3), A8 (c1&c2: 2-4), A17 (c1&c2: 3-5) 6 from STF 6 (3922g UZrH, 273g U235, 293g U, 3629g ZrH): A3T (c1&c2: 4-6), B5 (c1&c2: 1-5), A36 (c1: 6-5), A5 (c1&c2: 1-5), A41 (c1: 5-14, c2: 4-19), C5 (c1: 4-4, c2: 5-20)	795	853	11686	1.8	Aug-66	5
SN-9 (CAN-SF-91-1)	south	rack 901-3, D-2 (RK-SF-900-46 port 1)	12 complete STF elements 6 from STF 7 (3936g UZrH, 276g U235, 296g U, 3640g ZrH): C2 (c1: 5-16, c2: 4-17), A32 (c1&c2: 3-14), A27 (c1&c2: 4-5), A47 (c1&c2: 1-6), A40 (c1&c2: 1-1), A12 (c1&c2: 2-2) 6 from STF 8 (4002g UZrH, 280g U235, 300g U, 3702g ZrH): A15 (c1&c2: 3-3), B4 (c1: 1-4), A48 (c1: 4-18, c2: 5-19), A26 (c1&c2: 3-15), A11 (c1&c2: 4-19), C4 (c2: 4-18)	556	596	7938	1.3	Aug-66	7

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-10 (CAN-SF-91-13)	south	rack 901-2, F-5 (RK-SF-900-46 port 13)	13 complete STF elements 6 from STF 9 (3955g UZrH, 276g U235, 296g U, 3659g ZrH): A46 (c1&c2: 2-1), A25 (c1&c2: 3-2), A4 (c1: 4-15, c2: 5-2), B2 (c1: 5-9, c2: 6-8), A42 (c1&c2: 3-4), C3 (c1: 4-16, c2: 4-2) 6 from STF 10 (3903g UZrH, 255g U235, 273g U, 3630g ZrH): A22 (c1: 4-3, c2: 3-16), A28 (c1: 5-6, c2: 3-17), A43 (c1: 4-17, c2: 3-18), A14 (c1: 4-2, c2: 3-1), A29 (c1: 5-7, c2: 4-1), A6 (c1: 4-8) 1 from STF 11 (685g UZrH, 45g U235, 48g U, 637g ZrH): A49 (c1: 4-12, c2: 6-1)	576	617	8543	1.4	Aug-66	8
SN-11 (CAN-SF-91-8)	south	rack 901-2, F-8 (RK-SF-900-46 port 8)	6 complete 10FS-3 elements from 10FS-3 13 (8135g UZrH, 768g U235, 823g U, 7312g ZrH): 486 (2), 150 (28), 337 (29), 352 (37), 350 (30), 332(or 322) (10) and 18 complete S8ER elements from S8ER 1 (5563g UZrH, 513g U235, 549g U, 5014g ZrH): E249 (9-8), E212 (9-13), E471 (9-16), E281 (9-18), E146 (9-19), E164 (9-20), E149 (9-26), E245 (9-27), E237 (9-32), E383 (9-35), E291 (9-40), E137 (9-43), E292 (9-44), E280 (9-45), E311 (9-46), E313 (9-47), E350 (8-1), E424 (8-3)	1281	1372	13698	1.85	Jul-68	2, 9
SN-12 (CAN-SF-91-5)	south	rack 901-2, F-11 (RK-SF-900-46 port 5)	6 complete 10FS-3 elements from 10FS-3 14 (8138g UZrH, 772g U235, 829g U, 7309g ZrH): 338(or 388) (32), 365 (14), 136(or 316) (21), 348 (35), 333 (22), 479 (23) and 18 complete S8ER elements from S8ER 3 (5572g UZrH, 515g U235, 551gU, 5021g ZrH): E372 (8-21) , E402 (8-26) (or E412(8-8)), E187 (8-28), E439 (8-30), E174 (8-32), E433 (8-34), E153 (8-35), E150 (8-37), E286 (8-39), E154 (8-40), E462 (8-41), E247 (8-42), E475 (7-1), E431 (7-4), E483 (7-6), E403 (7-7), E359 (7-8), E441 (7-12)	1287	1380	13710	1.85	Jul-68	3, 7

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-13 (CAN-SF-91-7)	south	rack 901-2, F-9 (RK-SF-900-46 port 7)	6 complete 10FS-3 elements from 10FS-3 15 (8137g UZrH, 770g U235, 826g U, 7311g ZrH): 336 (18), 334 (19), 456 (11), 349 (31), 421 (15), 345 (20) and 18 complete S8ER elements from S8ER 4 (5575g UZrH, 509g U235, 545g U, 5030g ZrH): E191 (9-12), E478 (8-5), E274 (8-4), E141 (8-22), E389 (7-3), E440 (7-9), E463 (7-11), E516 (7-16), E310 (7-18), E384 (7-20), E437 (7-21), E367 (7-22), E488 (7-23), E449 (7-25), E470 (7-26), E283 (7-30), E446 (7-31), E457 (7-33)	1279	1371	13712	1.85	Jul-68	3, 7
SN-14 (CAN-SF-91-6)	south	rack 901-2, F-10 (RK-SF-900-46 port 6)	6 complete 10FS-3 elements from 10FS-3 16 (8141g UZrH, 776g U235, 833g U, 7308g ZrH): 439 (33), 419 (24), 390 (25), 364 (36), 393 (26), 484 (4) and 18 complete S8ER elements from S8ER 6 (5571g UZrH, 516g U235, 552g U, 5019g ZrH): E503 (9-2), E192 (9-37), E419 (7-5), E484 (7-10), E454 (7-13), E413 (8-31), E523 (7-15), E504 (7-24), E466 (7-34), E343 (6-1), E513 (6-2), E505 (6-4), E177 (6-5), E369 (6-6), E356 (6-7), E357 (6-8), E517 (6-10), E448 (6-12)	1292	1385	13712	1.85	Aug-68	2, 8
SN-15 (CAN-SF-91-3)	south	rack 901-2, F-12 (RK-SF-900-46 port 3)	6 complete 10FS-3 elements from 10FS-3 17 (8150g UZrH, 772g U235, 828g U, 7322g ZrH): 441 (16), 440 (6), 528 (5), 435 (12), 190 (27), 442 (34) and 18 complete S8ER elements from S8ER 7 (5566g UZrH, 512g U235, 548g U, 5018g ZrH): E458 (7-2), E323 (7-35), E508 (8-24), E506 (7-32), E421 (6-13), E353 (6-14), E530 (6-15), E481 (6-16), E429 (6-17), E501 (6-18), E422 (6-19), E526 (6-20), E348 (6-21), E477 (6-22), E532 (6-23), E456 (6-26), E400 (6-28), E531 (6-30)	1284	1376	13716	1.85	Aug-68	4, 6

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

Al (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-16 (CAN-SF-91-12)	south	rack 901-2, F-2 (RK-SF-900-46 port 12)	36 complete S8ER elements 18 elements from S8ER 8 (5573g UZrH, 516g U235, 552g U, 5021g ZrH): E330 (5-1), E289 (5-2), E315 (5-3), E201 (5-4), E443 (5-6), E482 (5-7), E361 (5-8), E370 (5-9), E518 (5-11), E487 (5-12), E472 (5-13), E496 (5-14), E461 (5-15), E489 (5-18), E427 (5-19), E434 (5-22), E392 (5-23), E509 (5-24) 18 elements from S8ER 9 (5563g UZrH, 512g U235, 548g U, 5015g ZrH): E420 (9-4), E319 (9-21), E423 (8-11), E490 (8-27), E308 (4-2), E271 (4-3), E303 (4-4), E522 (4-5), E408 (4-6), E155 (4-7), E278 (4-9), E336 (4-10), E352 (4-11), E416 (4-14), E521 (4-15), E425 (4-16), E500 (4-17), E511 (4-18)	1028	1100	11136	1.50	Aug-68	9, 10
SN-17 (CAN-SF-91-10)	south	rack 901-2, F-1 (RK-SF-900-46 port 10)	5 complete S2DR elements from S2DR 17 (5704g UZrH, 525g U235, 565g U, 5139g ZrH): (519-1) 24, IV-2 (1142g UZrH, 105g U235, 113g U, 1029g ZrH) (518-3) 36, III-10 (1141g UZrH, 105g U235, 113g U, 1028g ZrH) (510-5) 75, III-11 (1140g UZrH, 105g U235, 113g U, 1027g ZrH) (519-4) 55, II-6 (1139g UZrH, 105g U235, 113g U, 1026g ZrH) (517-7) 23, IV-14 (1142g UZrH, 105g U235, 113g U, 1029g ZrH) and 18 complete S8ER elements from S8ER 11A (5575g UZrH, 516g U235, 552g U, 5023g ZrH): E412 (8-8) (or E402 (8-26)), E415 (8-9), E430 (8-12), E397 (8-13), E479 (8-14), E451 (8-15), E272 (8-16), E452 (8-17), E453 (8-19), E411 (8-20), E428 (5-16), E499 (5-17), E417 (5-20), E322 (8-7), E529 (4-8), E445 (6-9), E360 (7-14), E349 (6-11)	1041	1117	11279	1.52	Aug-68	8, 6

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-18 (CAN-SF-91-19)	middle	32-A, yoke 966 (38-J, yoke 214)	7 10FS-3 elements from 10FS-3 18 (8218g UZrH, 779g U235, 837g U, 7381g ZrH): complete: 459 (17), 525 (7), 418 (13) sectioned: 482 (8) declad and sectioned: 529(or 524) (3), 331 (9), 422 (1) and from 10FS-3 19 (252g UZrH, 24g U235, 26g U, 226g ZrH): element samples: 529(or 524) (3), 422 (1), 331 (9) and ~1kg of Zr scrap metal added to can to increase sp. Gr. to 1.2 or more	803	863	8470	1.28 with Zr added	Aug-68	5, 4
SN-19 (CAN-SF-91-16)	middle	30-E, yoke 994 (38-D, yoke 891)	46 complete S8ER elements 18 elements from S8ER 10 (5577g UZrH, 514g U235, 550g U, 5027g ZrH): E464 (9-14), E231 (8-33), E485 (6-27), E520 (6-29), E447 (7-17), E394 (6-3), E442 (8-23), E347 (5-21), E436 (9-36), E337 (3-1), E426 (3-4), E493 (3-6), E524 (3-8), E329 (3-10), E287 (3-11), E346 (3-12), E379 (2-1), E514 (2-3) ~12 elements from S8ER 12 (2955g UZrH, 261g U235, 281g U, 2674g ZrH): E351 (4-12), E491 (7-29), E335 (2-5), E340 (9-7), E181 (2-6), E316 (8-36), E341 (9-10), E302 (9-5), E388 (6-25), E492 (3-2), and parts of E171 (9-6), E528 (3-9) 18 elements from S8ER 13 (5576g UZrH, 511g U235, 547g U, 5029g ZrH): E304 (9-31), E176 (9-24), E244 (9-39), E527 (9-38), E288 (9-23), E197 (9-22), E510 (3-5), E450 (5-10), E268 (9-30), E318 (9-3), E358 (2-2), E396 (8-10), E109 (8-2), E182 (9-11), E175 (8-38), E307 (3-7), E533 (9-34), E236 (9-48)	1286	1378	14108	2.1	Jul-69	?

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

Al (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
SN-20 (CAN-SF-91-15)	middle	30-D, yoke 993 (38-B, yoke 890)	18 complete SER elements 6 elements from SER 14A (4339g UZrH, 277g U235, 295g U, 4044g ZrH): T-1, U-2, U-1, 11R-4, M-5, R-2 6 elements from SER 15 (4339g UZrH, 277g U235, 295g U, 4044g ZrH): W-4, W-10, V-2, V-8, U-10, 9R-4 6 elements from SER 16 (4332g UZrH, 277g U235, 295g U, 4037g ZrH): X-6, Y-8, S-4, 10R-1, Y-2, R-5 and 21 pieces of elements from S8ER 14 (4577g UZrH, 426g U235, 468g U, 4109g ZrH): S8ER sectioned fuel (2555g UZrH, 234g U235, 262g U) E486 (3-3), E309 (5-5), E332 (8-25), E206 (9-15), E188 (8-6), E525 (7-28), E111 (9-42), E342 (1-1), E519 (4-1), E398 (4-13), E232 (6-24), E432 (8-29), E474 (2-4), E378 (9-28), E293 (9-29) 117-1 Exp. sectioned fuel (515g UZrH, 48g U235, 51g U) 117-1 Thermo-physical samples (86g UZrH, 8g U235, 9g U) 115-2 Exp. 3,4,5,6 declad remains (117g UZrH, 11g U235, 12g U) 115-2 Exp. 1,2 declad remains (155g UZrH, 15g U235, 16g U) 82-1 Exp. declad fuel remains (1149g UZrH, 110g U235, 118g U) and 2 S2DR samples: Rod NAA-67-2 (460g UZrH, 39g U235, 42g U, 418g ZrH) Rod NAA-67-20 (57g UZrH, 5g U235, 6g U, 51g ZrH) and 2 TRIGA pieces: (2540g UZrH, 61g U235, 305g U, 2235g ZrH)	1362	1706	20644	3.1	Jul-69	?

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-1 (CAN-SF-90-5)	south	rack 901-2, H-6 (RK-SF-900-59 port 8)	S8DR fuel, first 18.5 of DR-4: 314 (9-31) 697C1 (364.52g UZrH, 33.55g U235, 36.45g U) 251 (9-32) 696C1 (365.66g UZrH, 34.35g U235, 37.11g U) 205 (9-34) 698A1 (365.46g UZrH, 34.45g U235, 37.42g U) 294 (9-35) 706C4 (364.93g UZrH, 34.40g U235, 37.30g U) 563 (9-37) 702B3 (364.56g UZrH, 34.21g U235, 37.11g U) 355 (9-42) 700D1 (364.52g UZrH, 34.39g U235, 37.29g U) 196 (9-44) 698A3 (365.20g UZrH, 34.55g U235, 37.40g U) 532 (9-45) 705C2 (365.21g UZrH, 34.20g U235, 37.03g U) 315 (9-46) 708B2 (364.96g UZrH, 34.25g U235, 37.08g U) 296 (9-47) 697B4 (365.00g UZrH, 33.55g U235, 36.24g U) 372 (8-30) 704C1 (365.39g UZrH, 34.26g U235, 37.05g U) 561 (8-33) 703D1 (365.45g UZrH, 34.93g U235, 37.93g U) 345 (8-34) 701B1 (365.00g UZrH, 34.49g U235, 37.38g U) 539 (8-35) 700A4 (364.71g UZrH, 34.34g U235, 37.05g U) 237 (8-37) 704D4 (365.18g UZrH, 34.28g U235, 37.14g U) 420 (5-16) 696D2 (365.00g UZrH, 33.83g U235, 36.76g U) 560 (9-3) 711B4 (364.55g UZrH, 34.11g U235, 36.97g U) 156 (8-12) 704C2 (or 374 (8-22) 704C4) (365.53g UZrH, 34.24g U235, 37.06g U) ~.5 of 228 (8-27) 701B4 (~198g UZrH, ~18g U235, ~20g U)	637 ~634.38	686 ~687.77	 ~6768.83	Unknown	Sep-74	None

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-2	south	rack 901-2, H-9	S8DR fuel remnants, all of DR-8:	617	668		Unknown	Sep-74	None
(CAN-SF-90-8)		(RK-SF-900-59 port 11)	386 (6-1) 701B2 (223.91g UZrH, 21.12g U235, 22.84g U)	616.59	668.49	6610.2			
			131 (4-13) 693D3 (325.84g UZrH, 30.40g U235, 32.71g U)						
			657 (6-23) 697C4 (267.77g UZrH, 24.46g U235, 26.59g U)						
			396 (3-1) 712B2 (356.90g UZrH, 33.15g U235, 36.08g U)						
			562 (9-5) 693D2 (or 412 (4-5) 713B1)						
			(359.46g UZrH, 33.47g U235, 36.09g U)						
			673 (5-6) 705C3 (359.86g UZrH, 33.14g U235, 36.09g U)						
			472 (5-19) 706A4 (362.44g UZrH, 33.54g U235, 36.57g U)						
			531 (6-6) 703D4 (363.91g UZrH, 34.63g U235, 37.59g U)						
			699 (6-15) 644A4 (361.70g UZrH, 33.26g U235, 36.03g U)						
			140 (7-2) 706D3 (301.27g UZrH, 28.65g U235, 31.00g U)						
			061 (8-5) 698B4 (326.67g UZrH, 30.48g U235, 33.16g U)						
			738 (8-39) 702A3 (361.73g UZrH, 33.92g U235, 36.68g U)						
			151 (9-10) 696D1 (362.20g UZrH, 33.92g U235, 36.80g U)						
			334 (9-43) 695C2 (362.45g UZrH, 34.26g U235, 36.93g U)						
			545 (9-20) 704A2 (304.21g UZrH, 28.49g U235, 30.94g U)						
			328 (9-40) 696B3 (301.95g UZrH, 28.22g U235, 30.59g U)						
			723 (8-3) 696B4 (253.27g UZrH, 23.65g U235, 25.61g U)						
			271 (7-8) 699A4 (364.22g UZrH, 33.96g U235, 36.90g U)						
			111 (6-2) 698D1 (327.46g UZrH, 30.57g U235, 33.14g U)						
			127 (1-1) 695B3 (362.98g UZrH, 33.30g U235, 36.15g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-3	south	rack 901-2, H-2	S8DR fuel, 5.5 of DR-4:	595	646		Unknown	Sep-74	None
(CAN-SF-90-1)		(RK-SF-900-59 port 4)	~.5 of 228 (8-27) 701B4 (~167g UZrH, ~16g U235, ~17g U)	~593.62	~644.21	~6364.98			
			489 (8-31) 702C1 (364.47g UZrH, 34.10g U235, 36.99g U)						
			363 (8-2) 700D3 (364.62g UZrH, 34.31g U235, 37.23g U)						
			219 (8-11) 705B1 (364.71g UZrH, 34.13g U235, 36.98g U)						
			511 (8-38) 693C4 (364.44g UZrH, 34.21g U235, 37.06g U)						
			305 (8-40) 705A1 (365.07g UZrH, 34.16g U235, 37.05g U)						
			and 12 of DR-1:						
			720 (3-2) 706B2 (364.98g UZrH, 33.98g U235, 36.94g U)						
			116 (3-3) 698D3 (364.38g UZrH, 33.66g U235, 36.69g U)						
			579 (4-2) 705B4 (364.18g UZrH, 33.81g U235, 36.64g U)						
			650 (4-3) 701A2 (363.90g UZrH, 33.88g U235, 36.68g U)						
			730 (4-10) 700A3 (364.40g UZrH, 33.90g U235, 36.73g U)						
			101 (4-15) 698D2 (364.72g UZrH, 33.75g U235, 36.76g U)						
			655 (5-2) 693B3 (364.97g UZrH, 33.64g U235, 36.46g U)						
			710 (5-3) 702A1 (364.52g UZrH, 34.00g U235, 36.74g U)						
			146 (5-4) 698A4 (365.05g UZrH, 33.77g U235, 37.09g U)						
			471 (5-8) 700C2 (364.38g UZrH, 34.24g U235, 37.20g U)						
			168 (5-14) 705A4 (364.63g UZrH, 33.79g U235, 36.75g U)						
			108(5-20) 703B1 (364.56g UZrH, 34.29g U235, 37.22g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

Al (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-4	south	rack 901-2, H-8	S8DR fuel, 12 of DR-1:	579	628		Unknown	Sep-74	None
(CAN-SF-90-7)		(RK-SF-900-59 port 10)	402 (5-22) 695C3 (364.70g UZrH, 33.84g U235, 36.87g U)	579.32	628.11	6201.74			
			408 (5-23) 696A3 (364.67g UZrH, 33.22g U235, 36.10g U)						
			419 (5-24) 695D2 (364.70g UZrH, 34.16g U235, 37.05g U)						
			403 (6-5) 699C1 (364.63g UZrH, 33.82g U235, 36.79g U)						
			557 (6-8) 703A1 (364.15g UZrH, 34.31g U235, 37.14g U)						
			409 (6-9) 696A2 (364.56g UZrH, 33.31g U235, 36.16g U)						
			252 (6-16) 699D1 (365.72g UZrH, 33.78g U235, 36.90g U)						
			702 (6-19) 701C1 (364.67g UZrH, 34.48g U235, 37.34g U)						
			149 (6-20) 704D3 (364.53g UZrH, 33.96g U235, 36.93g U)						
			705 (6-22) 708A2 (364.71g UZrH, 33.64G U235, 36.40g U)						
			708 (6-24) 701C2 (364.49g UZrH, 34.53g U235, 37.32g U)						
			603 (6-25) 7;3C4 (364.94g UZrH, 34.54g U235, 37.30g U)						
			and 5 of DR-6:						
			338 (9-2) 706C1 (365.37g UZrH, 34.33g U235, 37.34g U)						
			018 (9-6) 704B2 (365.04g UZrH, 34.26g U235, 37.02g U)						
			422 (9-7) 712D3 (365.30g UZrH, 34.24g U235, 37.11g U)						
			439 (9-11) 712C2 (365.18g UZrH, 34.63g U235, 37.21g U)						
			010 (9-12) 697D2 (364.38g UZrH, 34.27g U235, 37.13g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-5	south	rack 901-2, H-3	S8DR fuel, 18 of DR-6:	615	666		Unknown	Sep-74	None
(CAN-SF-90-2)		(RK-SF-900-59 port 5)	322 (9-14) 693A4 (364.96g UZrH, 33.70g U235, 36.42g U)	614.93	666.43	6565.51			
			256 (9-15) 697B3 (365.02g UZrH, 33.46g U235, 36.25g U)						
			378 (9-16) 713A4 (364.73g UZrH, 34.05g U235, 36.91g U)						
			371 (9-18) 706C2 (365.61g UZrH, 34.46g U235, 37.40g U)						
			157 (9-19) 695D1 (365.16g UZrH, 34.45g UZrH, 37.39gU)						
			250 (9-23) 695C1 (365.38g UZrH, 34.47g U235, 37.23g U)						
			320 (9-26) 695A2 (364.27g UZrH, 34.19g U235, 37.05g U)						
			505 (9-27) 698D4 (364.39g UZrH, 34.23g U235, 37.09g U)						
			404 (9-28) 695B1 (364.31g UZrH, 33.97g U235, 36.76g U)						
			577 (9-29) 714A3 (364.64g UZrH, 34.47g U235, 37.41g U)						
			434 (9-30) 705B2 (364.52g UZrH, 34.14g U235, 37.04g U)						
			327 (9-38) 693B4 (364.44g UZrH, 34.16g U235, 36.74g U)						
			411 (5-13) 713D3 (365.41g UZrH, 34.67g U235, 37.67g U)						
			430 (6-10) 714C3 (364.38g UZrH, 34.22g U235, 36.98g U)						
			354 (8-4) 697D3 (364.48g UZrH, 34.18g U235, 37.07g U)						
			483 (8-10) 705D4 (364.58g UZrH, 34.48g U235, 37.44g U)						
			464 (8-26) 712C1 (364.80g UZrH, 34.25g U235, 37.10g U)						
			379 (3-8) 713A3 (364.43g UZrH, 33.38g U235, 36.48g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-6	south	rack 901-2, H-1	S8DR fuel remnants, all of DR-7 except 712A1:	640	694		Unknown	Sep-74	None
(CAN-SF-90-12)		(RK-SF-900-59 port 15)	133 (6-26) 712D4 (297.56g UZrH, 27.69g U235, 30.05g U)	639.68	694.03	6840.37			
			128 (6-29) 693D1 (364.48g UZrH, 33.84g U235, 36.74g U)						
			110 (4-4) 696B1 (363.37g UZrH, 33.41g U235, 36.45g U)						
			631 (5-7) 703C2 (362.63g UZrH, 33.90g U235, 36.81g U)						
			302 (5-17) 699A2 (362.34g UZrH, 33.62g U235, 36.56g U)						
			391 (5-18) 695A4 (363.02g UZrH, 33.40g U235, 36.63g U)						
			383 (5-21) 713B1 (363.33g UZrH, 34.04g U235, 36.88g U)						
			463 (6-14) 703D3 (363.27g UZrH, 34.95g U235, 37.53g U)						
			267 (7-6) 699C3 (364.36g UZrH, 33.97g U235, 36.84g U)						
			711 (7-17) 712B4 (362.86g UZrH, 34.04g U235, 36.94g U)						
			199 (7-18) 699A1 (363.55g UZrH, 34.00g U235, 36.83g U)						
			230 (8-15) 701C4 (363.16g UZrH, 34.24g U235, 37.33g U)						
			526 (8-19) 701A1 (363.70g UZrH, 34.03g U235, 36.95g U)						
			365 (8-23) 700D4 (363.17g UZrH, 34.10g U235, 37.08g U)						
			308 (8-29) 707B3 (362.85g UZrH, 33.84g U235, 36.50g U)						
			571 (8-32) 706A1 (362.76g UZrH, 34.02g U235, 36.68g U)						
			233 (8-28) 701D4 (364.56g UZrH, 34.30g U235, 37.19g U)						
			321 (9-24) 706C3 (365.06g UZrH, 34.37g U235, 37.31g U)						
			274 (8-41) 699B1 (364.34g UZrH, 33.92g U235, 36.73g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-7 (CAN-SF-90-4)	south	rack 901-2, H-5 (RK-SF-900-59 port 7)	S8DR fuel remnants, 712A1 from DR-7:	677	736		Unknown	Sep-74	None
			454 (4-12) 712A1 (360.05g UZrH, 33.79g U235, 36.55g U)	677.35	736.47	7294.77			
			and S8DR fuel, 19 of DR-5:						
			706 (3-4) 713B2 (365.22g UZrH, 33.96g U235, 36.96g U)						
			165 (4-7) 698C3 (364.17g UZrH, 33.99g U235, 36.98g U)						
			120 (4-16) 698C4 (364.37g UZrH, 33.97g U235, 36.91g U)						
			413 (4-17) 708D3 (364.75g UZrH, 34.23g U235, 36.99g U)						
			449 (4-18) 709A2 (364.89g UZrH, 33.40g U235, 36.27g U)						
			424 (5-10) 709C2 (364.55g UZrH, 33.71g U235, 36.60g U)						
			401 (5-11) 709D2 (367.13g UZrH, 33.92g U235, 36.90g U)						
			427 (7-26) 709B1 (364.90g UZrH, 33.58g U235, 36.53g U)						
			513 (8-13) 710D2 (364.66g UZrH, 34.60g U235, 37.38g U)						
			152 (9-39) 710A1 (364.63g UZrH, 33.60g U235, 36.50g U)						
			490 (9-48) 702D4 (364.77g UZrH, 34.56g U235, 37.39g U)						
			387 (3-10) 701D1 (364.37g UZrH, 33.67g U235, 36.84g U)						
			447 (3-11) 708B1 (365.32g UZrH, 33.57g U235, 36.71g U)						
			530 (3-12) 704B1 (366.08g UZrH, 33.79g U235, 36.68g U)						
			649 (4-11) 704D1 (365.11g UZrH, 33.79g U235, 36.84g U)						
			574 (6-11) 702A4 (364.51g UZrH, 33.64g U235, 36.82g U)						
			264 (7-13) 699C4 (365.91g UZrH, 34.10g U235, 36.99g U)						
			232 (7-14) 704D2 (365.07g UZrH, 34.13g U235, 37.05g U)						
			126 (7-35) 707B1 (364.31g UZrH, 33.35g U235, 36.58g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-8	south	rack 901-2, H-10	S8DR fuel, 5 of DR-5:	663	718		Unknown	Sep-74	None
(CAN-SF-90-9)		(RK-SF-900-59 port 12)	425 (6-3) 709B3 (364.77g UZrH, 33.58g U235, 36.44g U)	~662.38	~718.21	~7113.65			
			254 (6-4) 694C3 (364.52g UZrH, 33.59g U235, 36.49g U)						
			678 (6-28) 709A1 (364.58g UZrH, 33.45g U235, 36.35g U)						
			190 (7-9) 708C3 (364.61g UZrH, 33.95g U235, 36.83g U)						
			512 (7-23) 710D3 (364.93g UZrH, 34.45g U235, 37.33g U)						
			and 700A2 from DR-6:						
			538 (7-5) 700A2 (364.56g UZrH, 34.08g U235, 36.97g U)						
			and 13.5 of DR-2:						
			675 (6-30) 703C4 (364.43g UZrH, 34.31g U235, 37.10g U)						
			293 (7-1) 695D4 (364.67g UZrH, 34.29g U235, 37.20g U)						
			509 (7-3) 693D4 (364.19g UZrH, 33.62g U235, 36.78g U)						
			428 (7-7) 712D1 (364.71g UZrH, 33.92g U235, 36.91g U)						
			652 (7-10) 704B4 (365.12g UZrH, 33.89g U235, 36.84g U)						
			435 (7-21) 694D3 (364.19g UZrH, 33.51g U235, 36.35g U)						
			164 (7-22) 708B3 (364.77g UZrH, 34.32g U235, 36.91g U)						
			175 (7-27) 698C2 (364.87g UZrH, 34.30g U235, 37.18g U)						
			584 (7-29) 700A1 (364.40g UZrH, 34.33g U235, 36.95g U)						
			326 (7-32) 693B2 (364.98g UZrH, 33.59g U235, 36.61g U)						
			319 (7-36) 707A3 (365.00g UZrH, 33.66g U235, 36.54g U)						
			525 (8-6) 707C1 (364.73g UZrH, 33.91g U235, 36.98g U)						
			484 (8-9) 700C3 (364.62g UZrH, 34.63g U235, 37.45g U)						
			.5 of 570 (8-25) 708A1 (~185g UZrH, ~17g U235, ~18g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

Al (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-9	south	rack 901-2, H-4	S8DR fuel, all of DR-3:	716	776		Unknown	Sep-74	None
(CAN-SF-90-3)		(RK-SF-900-59 port 6)	137 (2-1) 695B2 (364.51g UZrH, 33.42g U235, 36.31g U)	715.54	775.68	7662.55			
			414 (4-14) 701B3 (364.44g UZrH, 34.20g U235, 37.03g U)						
			394 (5-12) 695A1 (364.99g UZrH, 33.88g U235, 36.83g U)						
			457 (6-12) 708A3 (365.40g UZrH, 33.78g U235, 36.47g U)						
			697 (6-13) 697A1 (364.19g UZrH, 33.70g U235, 36.60g U)						
			700 (6-17) 694B3 (364.99g UZrH, 33.74g U235, 36.54g U)						
			703 (6-18) 700B3 (364.47g UZrH, 34.25g U235, 37.18g U)						
			493 (7-11) 702C4 (364.40g UZrH, 34.00g U235, 36.91g U)						
			138 (7-12) 694B2 (364.51g UZrH, 33.79g U235, 36.56g U)						
			572 (7-15) 695D3 (364.55g UZrH, 34.34g U235, 37.18g U)						
			366 (7-19) 713A2 (364.83g UZrH, 33.78g U235, 36.77g U)						
			467 (7-20) 705D1 (365.08g UZrH, 34.50g U235, 37.42g U)						
			494 (7-24) 702C2 (364.59g UZrH, 34.16g U235, 36.93g U)						
			265 (8-1) 701A4 (365.73g UZrH, 34.23g U235, 37.16g U)						
			244 (8-8) 699B4 (365.61g UZrH, 33.92g U235, 36.85g U)						
			224 (8-14) 701D2 (364.62g UZrH, 34.34g U235, 37.19g U)						
			197 (8-16) 699A3 (365.08g UZrH, 34.17g U235, 37.06g U)						
			517 (8-17) 712B3 (364.98g UZrH, 34.34g U235, 37.23g U)						
			568 (8-18) 713C3 (365.45g UZrH, 34.71g U235, 37.50g U)						
			213 (8-20) 705A2 (364.93g UZrH, 34.26g U235, 37.04g U)						
			333 (8-21) 706A2 (365.20g UZrH, 34.03g U235, 36.92g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-10	south	rack 901-2, H-11	S8DR fuel, all of DR-10 except the pieces of 117-1:	691	752		Unknown	Sep-74	None
(CAN-SF-90-10)		(RK-SF-900-59 port 13)	236 (8-7) 702D1 (364.78g UZrH, 34.39g U235, 37.32g U)	690.72	748.61	7426.43			
			632 (6-27) 706D2 (365.18g UZrH, 34.56g U235, 37.50g U)						
			134 (6-21) 694D2 (365.37g UZrH, 33.52g U235, 36.39g U)						
			466 (5-9) 707D4 (364.47g UZrH, 33.81g U235, 36.59g U)						
			433 (6-7) 709C3 (364.64g UZrH, 33.82g U235, 36.68g U)						
			104 (4-9) 703B2 (364.53g UZrH, 34.13g U235, 37.15g U)						
			704 (4-6) 699D2 (364.46g UZrH, 33.47g U235, 36.63g U)						
			316 (2-5) 713C2 (365.05g UZrH, 34.05g U235, 37.09g U)						
			395 (2-4) 695A3 (364.51g UZrH, 33.56g U235, 36.63g U)						
			453 (2-3) 708A4 (365.49g UZrH, 33.58g U235, 36.26g U)						
			707 (2-2) 696C3 (364.84g UZrH, 33.52g U235, 36.56g U)						
			S8DR fuel remnants:						
			492 (7-4) 713A1 (351.67g UZrH, 32.71g U235, 35.45g U)						
			653 (5-1) 702D2 (307.49g UZrH, 28.71g U235, 31.27g U)						
			142 (7-28) 698B2 (245.53g UZrH, 23.08g U235, 24.87g U)						
			368 (7-30) 712D2 (304.12g UZrH, 28.14g U235, 30.78g U)						
			701 (4-1) 694A1 (338.46g UZrH, 30.71g U235, 33.61g U)						
			NAA 121 fuel remnants: Exp#1 E4570						
			694B1 I.D.113492 (178.88g UZrH, 17.46g U235, 18.75g U)						
			NAA 121 fuel remnants: Exp#2 E5204						
			694B4 I.D.113491 (178.88g UZrH, 17.33g U235, 18.60g U)						
			NAA 121 fuel remnants: Exp#3						
			694C4 I.D.113416 (167.88g UZrH, 16.26g U235, 17.46g U)						
			NAA 121 fuel remnants: Exp#4						
			644A3 I.D.113413 (191.20g UZrH, 18.52g U235, 19.88g U)						
			S8ER fuel: E339 (7-36) 562A3 I.D.106610 (310.00g UZrH, 28.41g U235, 30.50g U)						
			S8ER fuel: E410 (7-27) 561D2 I.D.106300 (299.00g UZrH, 27.57g U235, 29.60g U)						
			S8ER fuel: E515 (8-18) 560A2 I.D.113070 (312.00g UZrH, 28.39g U235, 30.48g U)						
			S8ER fuel remnants: E528 (3-9) 531A1 I.D.106910 (128.00g UZrH, 11.82g U235, 12.68g U)						
			S8ER fuel remnants: E171 (9-6) 549C4 I.D.106270 (100.00g UZrH, 9.20g U235, 9.88g U)						

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

Al (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-11 (CAN-SF-90-6)	south	rack 901-2, H-7 (RK-SF-900-59 port 9)	S8DR fuel remnants, 12 of DR-9: 536 (3-9) 697A4 (178.02g UZrH, 16.37g U235, 17.80g U) 268 (7-31) 699D3 (170.80g UZrH, 15.94g U235, 17.27g U) 452 (5-15) 709A3 (363.14g UZrH, 33.36g U235, 36.13g U) 389 (2-6) 711B1 (266.98g UZrH, 24.61g U235, 26.75g U) 398 (3-7) 712B1 (362.97g UZrH, 33.64g U235, 36.70g U) 141 (8-24) 707A2 (337.09g UZrH, 31.41g U235, 33.81g U) 337 (9-22) 702D3 (338.25g UZrH, 31.98g U235, 34.67g U) 226 (9-21) 697C3 (337.79g UZrH, 31.09g U235, 33.78g U) 195 (7-16) 700B4 (248.23g UZrH, 23.31g U235, 25.37g U) 397 (3-6) 710A3 (363.54g UZrH, 33.08g U235, 35.95g U) 103 (3-5) 708C4 (362.52g UZrH, 33.67g U235, 36.36g U) 374 (8-22) 704C4 (or 156 (8-12) 704C2) (363.09g UZrH, 33.98gU235, 36.82g U) S8DR fuel, 3.5 of DR-2: .5 of 570 (8-25) 708A1 (~179g UZrH, ~16g U235, ~19g U) 376 (8-36) 704C3 (365.43g UZrH, 34.01g U235, 37.05g U) 234 (8-42) 701D3 (364.46g UZrH, 34.36g U235, 37.17g U) 324 (9-8) 706D1 (364.93g UZrH, 34.76g U235, 37.70g U)	462 ~461.57	502 ~502.33	~4966.24	Unknown	Sep-74	None

Table 3: SNAP and AI Spent Fuel in Storage at ICPP (continued)

AI (Inner) Can # (SS Outer Can #)	CPP-603 Basin	Basin Location (old) (new position)	Current Can Contents based on Shipper's Can Label and Shipping Information	Total U235 in grams	Total U in grams	Total Fuel Wt. in grams	Sp. g of filled can	ICPP Date Received	Prior 603 Bucket #
AI-12	south	rack 901-2, H-12	117-1 fuel, 5 pieces from DR-10:	342	374		Unknown	Sep-74	None
(CAN-SF-90-11)		(RK-SF-900-59 port 14)	623D7, 626D7, 624B5 & 624B1, I.D.113499	342.32	370.9	3632.8			
			(63.00g UZrH, 5.86g U235, 6.29g U)						
			and the rest of DR-9:						
			S8DR fuel remnants:						
			132 (7-25) 695C4 (363.31g UZrH, 33.87g U235, 36.88g U)						
			426 (7-33) 709B2 (362.93g UZrH, 33.50g U235, 36.33g U)						
			185 (7-34) 714B1 (325.78g UZrH, 30.46g U235, 33.07g U)						
			144 (5-5) 710D1 (254.79g UZrH, 23.88g U235, 25.96g U)						
			416 (4-8) 708D4 (291.17g UZrH, 27.29g U235, 29.52g U)						
			061 (8-5) 698B4A (12.03g UZrH, 1.12g U235, 1.22g U)						
			2 ARCHIVE elements:						
			E335 693B1 ID115255 (236.39g UZrH, 23.12g U235, 24.82g U)						
			E564 703A3 ID115980 (265.05g UZrH, 26.32g U235, 28.25g U)						
			S8DR fuel:						
			529 (9-36) 693C3 (364.13g UZrH, 34.35g U235, 37.10g U)						
			573 (9-13) 693C2 (364.42g UZrH, 34.42g U235, 37.13g U)						
			412 (4-5) 713B1 (or 562 (9-5) 693D2)						
			(364.79g UZrH, 33.95g U235, 37.32g U)						
			486 (9-4) 704B3 (365.01g UZrH, 34.18g U235, 37.01g U)						

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