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SNAP POWER FOR HARDENED BASES

1962

Division of North American Aviation, Inc.
Atomics International
Canoga Park, California

AEC Research and Development Report

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SNAP POWER
FOR
HARDENED BASES
(Title Unclassified)

Briefing by SNAP Reactors Branch, USAEC

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I. INTRODUCTION

A. PROGRAM HISTORY AND OBJECTIVES

The SNAP (Systems for Nuclear Auxiliary Power) Program began as a joint AEC-Air Force program in 1955. At that time, the AEC began studies of nuclear systems to meet requirements for light-weight long-lived power sources for satellites and space vehicles. It was obvious then, as today, that most space missions would be severely limited by the high weights and short lives of existing power sources. It was apparent that nuclear systems could be developed to provide electrical power sources exhibiting long-lived unmanned automatic operation, ruggedness, compactness, and a high degree of reliability. Today, two low-power SNAP isotope generators have been in successful orbital operation in TRANSIT IV satellites for several months. Flight-testing of the higher-powered reactor systems will be initiated next year. Operational nuclear systems will furnish electrical power for both payload operation and electrical propulsion, and will be the only sufficiently compact long-lived power systems available to space mission planners.

Table I gives a detailed listing of approved SNAP systems. Table II gives objectives for compact nuclear power systems.

TABLE II
OBJECTIVES FOR COMPACT NUCLEAR POWER SYSTEMS

-
1. Unattended Operation and Remote Startup
 2. Extreme Reliability
 3. Extreme Safety and Radiological Containment
 4. Compatible with Water or Atmospheric Environment
 5. Sufficiently Compact for Mobile Use and for
Total Unit Assembly and Shipment
 6. Easily Adaptable to Various Uses and Vehicles
 7. Economically Attractive to Military Field Operations Forces
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II. CURRENT SNAP SYSTEMS

Table III is a summary of the present SNAP systems, and Figure 1 illustrates them. SNAP systems 3, 7, 9, 11, 10A, 2 and 8 are under active development to meet specific flight test schedules.

Several of these space systems are now in use or being developed for terrestrial applications.

The last column in Table III summarizes a SNAP project which takes advantage of the technology developed for space but is specifically directed toward meeting terrestrial remote-site power needs. This project, SNAP 4, has a variety of applications but is not being pursued as vigorously as are those which have specific space test flight schedules to meet.

TABLE III
COMPARISON OF PRESENT SNAP SYSTEMS

Designation	SNAP 3, 7, 9, 11	SNAP 10A	SNAP 2	SNAP 8	SNAP 4
Electrical Power	1-300 watts	500 watts	3 kwe	30-60 kwe	2000 kwe
Power Source	Radioisotope	Reactor	Reactor	Reactor	Reactor
Power Conversion By	Thermoelectric	Thermoelectric	Mercury turbogenerator	Mercury turbogenerator	Steam turbogenerator
Life	1-5 yr	1 yr	1 yr	1 yr	1 yr
Weight (unshielded)	-	525 lb	750 lb	1500 lb (30 kw) 2600 lb (60 kw)	40,000 lb
Current Annual Funding	\$3 million	\$11 million	\$20 million	\$6 million (AEC)	\$1 million
Development Status	Available on 6 mo notice. New adaptations require 9-12 mo. Priority needed for isotopes.	Reactor proven in tests System ground tests start October '62.	System ground tests start March '63.	Power reactor tests start April '62. System ground tests start October '62.	Critical experiments completed. Final operation of system could be available in 4 years.

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SNAP 4

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Figure 1. Present SNAP Systems
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A. SNAP SOURCES AND POWER CONVERSION METHODS

The SNAP program currently has developed a technology which allows a flexibility of design not available in other systems. Today, in hardware status, we have two primary nuclear energy sources and two methods of conversion to electrical power.

The heat sources are radioisotopes and reactors. For converting this heat to electricity, either thermoelectric generators or high-performance turbine-alternators are used.

Each of these sources and power conversion methods has unique features.

Sources

- 1) Radioisotope sources provide an extremely long-lived source of heat at a weight considerably lower than that of conventional sources.
- 2) SNAP reactors use a U-Zr alloy hydride as fuel, which contains a high density of hydrogen (the best neutron moderator) in a solid form. This leads to a near thermal reactor of minimum size with very low U^{235} inventory whereas the fast reactor requires a large inventory of U^{235} (≈ 100 kg). The very small size ($< 1 \text{ ft}^3$ of core volume) allows control of the reactor by rotating reflector segments thus further decreasing overall reactor size.

Power Conversion Methods

- 1) Thermoelectric conversion is inherently reliable due to the absence of moving parts. The technology developed in the SNAP program has lead to the first successful use of direct thermoelectric conversion in space missions (TRANSIT IV).
- 2) The turbogenerator concept used in the several SNAP systems provides all the rotating equipment on one shaft and is thus highly compact and inherently reliable. Bearing lubrication is performed by the cycle working fluid (Hg or water, depending on the system) which reduces system complexity and enhances reliability.

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SOURCES

Radioisotopes

Reactors

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POWER CONVERSION

Thermoelectricity

Turbogenerator

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Figure 2. Sources and Power-Conversion Methods

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B. RELIABILITY OF SEALED EQUIPMENT

Generally, the most reliable systems are those which have no moving parts. Due to the low conversion efficiency of solid-state devices it is impractical to build high-capacity power plant equipment of truly static components. Therefore rotating equipment of the most reliable design is used.

One class of rotating machinery that is truly reliable is the motor-compressor of a common home refrigerator. Another is the canned rotor water pumps in use in the nuclear industry. These are simple compact sealed self-lubricated units. The refrigerator unit has an expected life of many years. These sealed nuclear pumps have this same reliability. This is the most promising approach to achieve high reliability; it is the approach used in the SNAP rotating equipment.

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Canned Rotor Pump
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SNAP 4 CRU

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Figure 3. Reliable Machinery

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III. NUCLEAR POWER FOR UNDERGROUND FACILITIES

A. SNAP 3, 7, 9, 11 (1-300 Watts Electrical)

In the 300-watt range, the optimum in reliability, simplicity of operation, and long life is offered by the combination of a radioisotope heat source and thermoelectric power-conversion equipment.

Figure 4 shows one of the SNAP 7 series now furnishing 5-25 watts of d-c power for remote unattended weather stations and navigation beacons. There are no moving parts and no circulating fluids in this system. Heat is given off by radioactive decay of the isotope material in the center of the device. This heat is converted to electricity by the thermal gradient established in the thermoelectric elements, which are heated directly by conduction on one surface and cooled by convection by means of fins located at the outside surface. Units using a variety of isotopes have been built. Device designs to about 100 watts are available. Supply of fuel is now limited by the facilities available for separation of radioactive isotopes and preparation of the final fuel form. About 6 months would be required for delivery of duplicates of present power units, and about 9-12 months for units requiring significant re-design.

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Figure 4. SNAP 7C

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B.. SNAP 6 (0.3-100 kwe)

In the 300 watt to 100 kwe range for terrestrial power systems, the reactor-thermoelectric generator combination offers an attractive system. The SNAP 6 system shown in Figure 5 is a 6-kwe thermoelectric system designed for an underwater application. This system employs a SNAP 2 reactor coupled to a thermoelectric generator by means of a natural circulation liquid-metal loop. In this particular configuration the thermoelectric materials are cooled by natural circulation of the surrounding sea water, but such systems could be adapted to land use by various means of air or forced water cooling. Units of this type could be available with power outputs up to about 100 kwe or greater allowing 3 to 4 years for development including prototype testing of about 6 months.

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SNAP 2 Experimental Reactor (SER)

100 kw/6 kwe
3000 lb
PbTe converter
1 ft-6 in. diam by 11 ft high
NaK cooled by natural
convection

6 kwe SNAP 6 Power Plant

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Figure 5. SNAP 6B
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1. 350-kwe Cycle Diagram

Figure 7 is a schematic of the cycle of a 350-kwe SNAP 8 plant. The reactor supplies heat to the closed NaK loop, which in turn supplies heat to the steam generator. The superheated steam is expanded through a conventional steam turbine. This particular system depicts operation with an artificial water reservoir for a heat sink.

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Figure 7. 350-kwe SNAP 8

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2. 350-kwe Data

Table IV shows the essential features of a 350-kwe SNAP 8 plant. This is the same reactor that is now being developed for the SNAP 8 space system.

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TABLE IV
SNAP 8 GROUND POWER

POWER GENERATION (ELECTRICAL)	{ 350 kw 60 CYCLE
POWER GENERATION (THERMAL)	1770 kw
OPERATING TEMPERATURE MAXIMUM	800°F NaK
OPERATING PRESSURE MAXIMUM	800 psi H ₂ O
FULL POWER	1-1-1/2 YEAR
COOLING WATER REQUIRED	200 gpm
AVAILABILITY	30-36 MONTHS (PRODUCTION MODELS)

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D. SNAP 4 POWER SYSTEM

1. Introduction

The SNAP 4 system is a compact transportable power system which utilizes a nuclear reactor heat source to generate steam, which in turn drives a compact high-speed steam-turbine Combined Rotating Unit (CRU) which generates 2000 kw of 400-cps electrical energy.

The steam from the reactor flows through a water-steam separator to a steam turbogenerator set and condenses at high back pressure, which permits the use of a compact condenser.

The unique feature of this system is that it utilizes a high-speed combined rotating power-conversion unit in which the turbine, 400-cycle alternator, and all the pumps in the system are mounted on a single shaft. Consequently, the power system, when in operation, has only one moving component, and the high speed significantly reduces the size of the conversion unit. Normal steam plant auxiliaries have been eliminated by hermetically sealing the system to eliminate the need for feedwater makeup.

As a result, the overall power system size has been reduced to a small envelope which permits packaging in a single intact unit. The system can be built at various power levels.

Figure 8 shows the component arrangement of the basic SNAP 4 compact nuclear power system.

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Figure 8. SNAP 4 Multipurpose Compact Nuclear Power System

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2. Reactor

The SNAP 4 reactor has a zirconium-hydrided uranium-fueled fixed-hydrogen-moderated core, with rotating reflector-drum controls similar to the SNAP space reactors.

Because this is a moderated reactor, a low critical mass of U^{235} is possible, improving the economy of the system as well as its controllability and safety.

The lightweight reactor shielding is composed of conventional materials; steel, water and lead. It is relatively simple to fabricate, and cooling is readily achieved. There are, besides the reactor vessel, laminates of steel and water, in which the high-energy neutrons are slowed down and absorbed. A thickness of lead completes the gamma shield and a stagnant pool of borated water completes the neutron shield. A weight optimization study indicates that the above combination and configuration provide the minimum weight for low-cost shield materials. Figure 9 shows the SNAP 4 reactor.

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Figure 9. SNAP 4 Reactor

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3. Compact Reactor Comparison

This comparison of the BWR, PWR, GCR, Fast, and SNAP 4 concepts at 12 Mwt for 1 year of continuous operation presents the size relationships of these systems.

In a mobile or transportable reactor the shielded volume is very critical. The large BWR, PWR, and GCR thermal cores require poison insertion control. The BWR's and PWR's accomplish this by means of axial control drives which must withdraw rods from the core. Thus, the shielded volume, core, reflector, and controls of these systems are about four times the core volume. The use of cantilevered flag controls and safeties in the GCR reduces the shielded volume requirement somewhat. The reflector rotating drum controls of the fast reactor or the small epithermal reactor (SNAP 4) provide the minimum volume system. However, the compact fast reactors are usually cooled with liquid metal, which becomes radioactive. This activity appears in the primary heat exchanger. This heat exchanger will vary in volume from 7 to 15 ft³ in volume, thus the total shielded volume of the fast system is at least twice as great as the SNAP 4 reactor.

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Figure 10. Compact Reactor Heat Source, 12 Mw Thermal for 1 Year

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4: Flow Cycle Diagram

The flow system, Figure 11, consists of three interconnected loops. One loop starts at the reactor, carries the steam-water mixture to the separator, and then returns the water to the reactor through the recirculation pump. The second loop is the power conversion loop, in which the steam from the separator is expanded through the turbine, condensed, pumped through the shield cooling passages and the regenerative heaters by the hot well pump, and then returned to the reactor by the high-pressure feed pump. The third loop is the bearing lubrication system. The flow in this loop starts at the high-pressure side of the recirculation pump, passes through regenerative and non-regenerative heat exchangers, where it is subcooled, passes through a demineralizer and filter, where soluble and insoluble corrosion products are removed and the pH adjusted, and finally passes through the bearings and the alternator cooling coils, then re-enters the suction side of the recirculation pump.

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Figure 11. Sealed Single Loop System

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5. Combined Rotating Unit (CRU)

The primary component of the SNAP 4 power-generation system is a hermetically sealed compact combined rotating unit of a type that has been shown to be feasible in current SNAP space systems. It consists of a high-speed steam turbine generating unit, in which the turbine, 400-cycle alternator, and all the pumps in the system are on one shaft. Except for controls, this is the only moving component in the power system.

Figure 12 shows a drawing of the proposed CRU.

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2 MWe POWER CONVERSION UNIT

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Figure 12. 2 Mwe Power-Conversion Unit

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6. Power-Conversion Unit Comparison

Lubricating and cooling with low-viscosity working fluids and the use of high condensing pressures to obtain small lightweight condensers have greatly reduced the weight and size of the SNAP 4 system.

Figure 13 illustrates the effect of applying reactor and space power-machinery technology to underwater systems. The inset shows relative sizes of the Combined Rotating Unit compared to conventional steam or gas cycle equipment which would be required to produce the same power output.

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Figure 13. 2-Mwe Conversion Unit Comparison

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7. SNAP 4 Comparison to Other Nuclear Power Plants

The AEC and DOD have built several reactor power systems of the 1-2 Mwe power range, which are now in various stages of operation. Basically, the developers of these plants have scaled down large civilian reactors and coupled these with conventional power-conversion equipment. No coordinated development effort aimed at optimum compactness and reliability has been conducted.

Figure 14 is a comparison of features of SNAP 4 with those of the PM-2A, a typical existing plant, in operation in a tunnel layout in Greenland. These features are chosen to illustrate the results of the coordinated simplification and compactness incorporated into SNAP 4.

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	PM 2A	SNAP 4
POWER (kwe)	1.5	2.0
LENGTH OF TUNNEL REQUIRED (ft)	500	40
FIELD ERECTION EFFORT (manhours)	115,000	100
OPERATION CREW REQUIRED	22	4

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Figure 14. Comparison of SNAP 4 with PM-2A
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E. 2000-kwe STANDARD STEAM-CONVERSION SYSTEM

1. Introduction

In the 2 Mwe range it is possible to couple the SNAP 4 reactor to a standard 60-cycle steam power-conversion system. This would require a minimum of three separate modules. System development could be accelerated to give a 2 Mwe plant in about 2 to 3 years. This scheme also has the advantage that it would make an important contribution to the ultimate SNAP 4 program.

Figure 16 shows the plant as it might be packaged and installed in a remote power station

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Figure 16. 2000 Electrical kw Remote Power Station

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2. Plant Modules

Figure 17 shows the modules required for the 2000-kwe system. The SNAP 4 reactor supplies to this conventional turbine generator high-pressure steam which is condensed and pumped back into the reactor as makeup. The conventional generator supplies 60-cycle power.

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a. Reactor Module

b. Turbine-Generator Module

c. Condenser and Auxiliaries Module

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Figure 17. Reactor Modules

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3. Data Table

Table V shows the essential features of the 2000-kwe plant that employs conventional 60-cycle power-conversion equipment.

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TABLE V
TRANSPORTABLE NUCLEAR POWER CHARACTERISTICS

NET ELECTRICAL POWER (0.8 P _f)	{ 2000 kw 60 CYCLE - 3 PHASE 2400/4160 VOLTS
FULL POWER OPERATION	1 YEAR
THERMAL POWER	10,200 kw
OPERATING TEMPERATURE	533°F
STEAM PRESSURE (REACTOR)	1220 psia
STEAM EXHAUST PRESSURE	3 in. Hg
STEAM FLOW	32,500 LB/HR
CLIMATE CONDITIONS	{ 100°F MAXIMUM -60°F MINIMUM
COOLING WATER	2000 gpm
SIZE (EACH MODULE)	8 FT DIAM BY 14 FT
WEIGHT: REACTOR MODULE	59,600 LB
TURBINE-GENERATOR MODULE	31,000 LB
CONDENSER-AUXILIARIES MODULE	22,500 LB
TOTAL	113,100 LB
CAPITAL COST	\$1.7 MILLION
OPERATING COST (YEARLY)	\$238,000
AVAILABILITY	24-36 MONTHS

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F. CURRENT DEVELOPMENT STATUS AND SCHEDULE

The SNAP 4 Power-Generating System has been under study and development by the Atomic Energy Commission since FY 1960. During the three years that the program has been in existence, the AEC has conducted feasibility and conceptual design studies of the nuclear power system to meet a basic Navy underwater requirement; initiated a fuel properties, fuel fabrication development, and fuel irradiation program; initiated preliminary analysis and design of the required development reactor system; operated the first critical assembly in support of the reactor design effort; and established the details of the development program required to advance from the present state-of-the-art to that state-of-the-art reflected by the design of the final SNAP 4 Power-Generating System.

Figure 21 shows the possible development schedule for the SNAP 4 system.

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2-4 MWe NET OUTPUT
1 YEAR OPERATION-UNATTENDED
AIR TRANSPORTABLE, 1-3 PACKAGES

HYDRIDE FUELED, BOILING WATER COOLED REACTOR
COMPACT, LIGHT WEIGHT, HIGH SPEED
HERMETICALLY SEALED, STEAM POWER
CONVERSION SYSTEM

A detailed black and white cross-sectional diagram of a vintage automobile chassis. The diagram shows the internal components, including the engine block, transmission, and rear axle assembly. The chassis is shown from a side-on perspective, highlighting the mechanical layout within the vehicle's frame.

GFY	1962	1963	1964	1965	1966	1967	1968
DEVELOPMENTAL REACTOR SYSTEM							
CRU DEVELOPMENT							
PROTOTYPE SYSTEM SUPPORTING DEV.							
PROTOTYPE SYSTEM							
FIELD EVALUATION							

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Figure 21. SNAP 4 System

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V. SUMMARY

In summary, SNAP power plants are available in a variety of power capabilities required for remote power stations.

In the submegawatt range are the extremely reliable, highly compact plants of the types developed for the space program. The combination of a simple rugged reactor, requiring practically no mechanical controls, with static thermoelectric power conversion will result in plants which are inherently reliable.

Where megawatts or hundreds of kilowatts are required, the SNAP 8 or SNAP 4, coupled with conventional steam cycle equipment, could be available in the time it would take to construct the bases currently being programmed.

For future bases, a 4- or 5-year program would yield tested, hermetically sealed plants which are truly automatic and self-regulating. Any of these plants would supply its design power for at least 1 year without refueling.

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REFERENCES

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1. AI-3471, "Feasibility Study for Compact Mobile Nuclear Power Plant," February 15, 1959 (Classified Report)
2. NAA-SR-5405, "Preliminary Design of a Compact Nuclear Power Plant for Underwater Application," AI, July 15, 1960 (Classified Report)
3. NAA-SR-5962, "Feasibility Study and Preliminary Design of Nuclear Thermoelectric Power Plants for Underwater Application," AI, January 10, 1961 (Classified Report)
4. NAA-SR-6595, "SNAP 4 Development Program," AI, August 7, 1961 (Classified Report)
5. NAA-SR-6684, "Preliminary SNAP 10A-SNAPSHOT Safety Report," AI-LMSC, February 26, 1962 (Classified Report)
6. NAA-SR-6791, "Progress Report, SNAP 2 Nuclear Auxiliary Power Unit Development, July-September," AI, February 1, 1962 (Classified Report)
7. NAA-SR-6792, "Progress Report for SNAP 8 Reactor Development, July-September 1961," AI, to be published (Classified Report)
8. NAA-SR-6793, "Progress Report, SNAP 10A Nuclear Auxiliary Power Unit Development, July-September 1961," AI, February 1, 1962 (Classified Report)
9. NAA-SR-6795, "Progress Report for SNAP 4, July-September 1961," AI, December 15, 1961 (Classified Report)
10. NAA-SR-6796, "Progress Report for SNAP Supporting R&D, July-September 1961," AI, November 15, 1961 (Classified Report)
11. NAA-SR-6991, "Progress Report, SNAP 2 Nuclear Auxiliary Power Unit Development, October-December 1961," AI, to be published (Classified Report)
12. NAA-SR-6993, "Progress Report, SNAP 10A Nuclear Auxiliary Power Unit Development, October-December 1962," AI, to be published (Classified Report)
13. NAA-SR-6995, "Progress Report for SNAP 4, October-December 1961," AI, to be published (Classified Report)
14. NAA-SR-6996, "Progress Report for SNAP Supporting R&D, October-December 1961," AI, February 15, 1962 (Classified Report)
15. NAA-SR-7088, "Final Report on the SNAP 2 Experimental Reactor (SER) Operation and Test Program," AI, to be published (Classified Report)

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