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TRAINING OF CONSUMERS PUBLIC POWER DISTRICT PERSONNEL FOR THE OPERATION OF THE HALLAM NUCLEAR POWER FACILITY

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DISCLAIMER

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I. INTRODUCTION

Training of Consumers Public Power District (CPPD) operating personnel for the Hallam Nuclear Power Facility (HNPF) was carried out under two formalized training programs. Both programs were organized and directed by Atomics International (AI). The first program was conducted in 1960 while the HNPF was under construction. The second program was begun in September 1961, prior to the initial HNPF dry critical loading experiment, and was completed in February 1963.

The training program carried out during construction of the HNPF was attended by 30 CPPD personnel and was of approximately six months duration. The program was divided into 14 subject areas; five areas were covered at Lincoln, Nebraska, and nine were covered at Canoga Park, California. Participants were divided into three general groups on the basis of education and availability. The program was therefore carried out in three sessions. Each session covered essentially the same subject material with the exception that nondegreed participants were initially given a review of basic math and physics. A course on general nuclear theory and technology was presented to all participants, and lectures on the operational and design characteristics of all HNPF systems and subsystems were delivered. Finally, practical instruction in reactor operational techniques and safety procedures was carried out at Canoga Park, California, utilizing the L-77 Training Reactor and the Sodium Reactor Experiment facilities. Total instruction time for this program was approximately 900 hours. Certain personnel were given additional specialized training.

The second training program, which was started on site in September 1961, was designed primarily for training reactor operators preparatory to their taking AEC reactor operator license examinations for the HNPF. Prospective CPPD and AI reactor operators were jointly included in the program. The number of personnel involved was too large for a single class. Also, testing of the reactor was scheduled to proceed simultaneously with training. Therefore, this training program was also divided into three sessions. Each session covered essentially the same material and consisted of approximately 300 hours of formalized training which was delivered over a four to six months period. Material covered included applied nuclear engineering, health physics and safety practices, a detailed presentation of all HNPF systems, and instruction in

operation of these systems using the installed HNPF hardware. Attendees of the first session took AEC reactor operator cold license examinations. Attendees of the second and third sessions took AEC reactor operator hot license examinations. Thirty CPPD and 22 AI personnel were trained and received AEC reactor operator licenses for the HNPF.

II. SHELDON STATION: GENERAL DESIGN FEATURES AND ORGANIZATIONAL STRUCTURE

In order to better understand training requirements, it is desirable to briefly review the general design features of Sheldon Station and its organizational structure. Sheldon Station, which is part of the Consumers Public Power District generation system, has both conventional and nuclear steam generation facilities. The overall complex is called Sheldon Station; the nuclear facility is designated as the Hallam Nuclear Power Facility. The HNPF was a joint effort of Consumers Public Power District and the U. S. Atomic Energy Commission and was built as part of the Power Reactor Demonstration Program. Atomics International designed and built the reactor under contract to the U. S. AEC. The conventional facility consists of a coal and/or gas-fired boiler, a turbogenerator, and the usual conventional steam plant support equipment. General design characteristics are:

Turbine:	nominal 100,000 kw capacity
Boiler:	capable of producing roughly 830,000 lb/hr of steam at 950 psig and 905°F; design features will permit eventual use for production of 790,000 lb/hr of steam at 1900 psig and 1005°F with 1005°F reheat.

HNPF hardware consists of a sodium graphite reactor with three sodium loops, three steam generators (one for each loop), and supporting and auxiliary system equipment. General characteristics are:

Reactor Power:	256 Mwt
Design total Na flow in all three loops:	approximately 8.4×10^6 lb/hr
Design total steam production from all three steam generators:	approximately 752,000 lb/hr at 800 psig and 843°F.

Either the conventional or the nuclear facility may be used to generate steam, since both facilities discharge steam into a common header leading to the turbine. In the future, a second turbine may be installed. The conventional and nuclear steam generation facilities would, at that time, each serve separate turbines. Such installation would more than double the current power capability of the station.

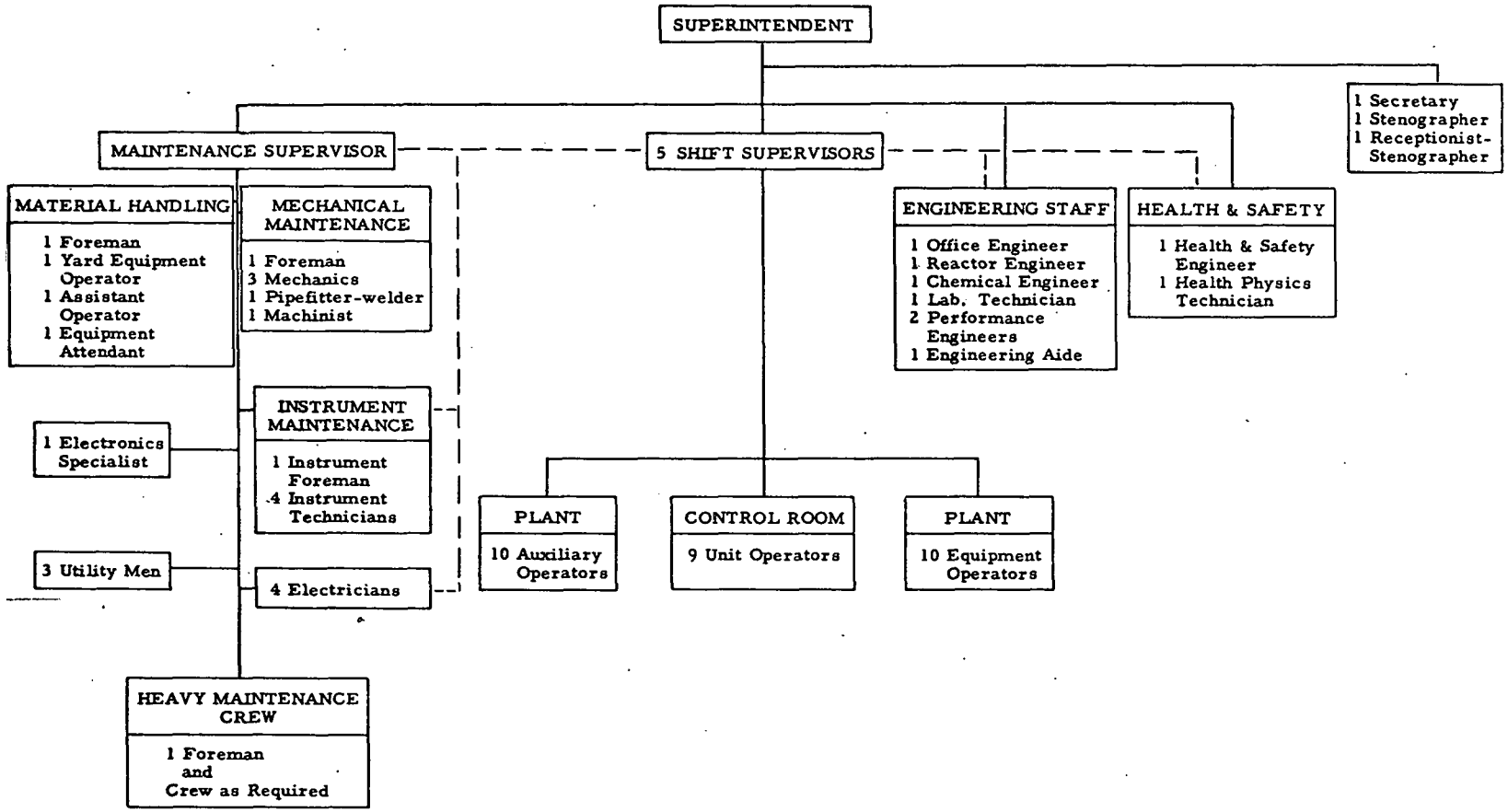
Ground breaking for the site took place on June 28, 1958; construction of the main plant buildings began in April 1959. Steam was first produced by the conventional plant in April 1961, and the conventional plant went fully commercial as of July 1, 1961. The first CPPD training program for the HNPF was conducted during 1960, while the plant was under construction. HNPF "dry" criticality was reached on January 19, 1962 and "wet" criticality on August 25, 1962. Wet excess experiments were completed in November 1962, and the HNPF rise-to-power was initiated in December 1962. Full design power operation of the HNPF (75 Mwe) was achieved on July 16, 1963. The second CPPD training program was begun in September 1961, a little more than four months before dry criticality was achieved, and was completed in February 1963.

CPPD organizational structure is shown on the Sheldon Station organizational chart included in this report. A shift operating crew normally consists of the following eight men:

1 Shift Supervisor
2 Unit Operators
2 Equipment Operators
2 Auxiliary Equipment Operators
1 Instrument Technician or Electrician

During shift operations, the shift supervisor has overall responsibility for operation of Sheldon Station. The station control room is divided into two sections: the conventional power plant section and nuclear power plant section. Two unit operators usually work in the control room; one operates the conventional side and the other operates the nuclear side. Unit operators are trained to run either facility and are rotated from one side to the other on a regularly scheduled basis. Equipment and auxiliary equipment operators operate equipment in either the conventional or nuclear facility as directed by the unit operators or by the shift supervisor. These men have also been trained to operate both the conventional and nuclear plant equipment and are regularly rotated from one facility to the other. Electricians and instrument technicians are familiar with the electrical hardware and instrumentation of the entire station. The shift organizational structure which was used throughout construction and reactor startup and testing at the HNPF was identical to that described above, with the following exceptions:

SHELDON STATION ORGANIZATION



a) An AI Shift Leader was given overriding authority

b) One or more AI test engineers were often present on shift during performance of their tests

c) Several contractual personnel were used to gather test and other data.

All CPPD shift personnel are thoroughly familiar with the operation of the conventional power plant. CPPD management has conducted several formalized training programs to instruct its personnel concerning operation of the conventional plant. In addition, the majority of CPPD's employees have had extensive prior experience in conventional power plant operation.

III. 1960 TRAINING PROGRAM

The first training program for CPPD personnel was developed and carried out by Atomics International in 1960 while the HNPF was under construction. The criteria for the development and presentation of this program are described in Final Summary Safeguards Report for the Hallam Nuclear Power Facility, NAA-SR-5700. They are as follows:

a) HNPF operations personnel should have an understanding of the potential hazard of a nuclear power plant. Also, they should be cognizant of the inherent safety features of a sodium graphite reactor plant and the considerations given to safety during the design of the HNPF.

b) HNPF operations personnel should have an understanding of the physical and operational characteristics of the HNPF components and systems.

c) HNPF operations personnel should have a basic knowledge of nuclear physics, nuclear instrumentation, and reactor terminology.

Three assumptions concerning the educational background and experience of the trainees were made. These assumptions were:

a) That each trainee had completed one high school algebra course and would regain a basic working knowledge of algebra after a brief review of the subject.

b) That each trainee had had conventional steam plant operating experience or would receive steam plant training at the Sheldon Station.

c) That many of the trainees had little or no nuclear reactor operating experience. Therefore, the training program would be designed to give the trainee a basic knowledge of nuclear technology and practical experience in reactor operational techniques.

The program was divided into 14 subject areas. Of these, five were presented at Lincoln, Nebraska, and nine at Canoga Park, California. All of the training classes were conducted by AI personnel with exception of the classes in three of the subject areas. These three areas – basic mathematics, physics, and instrumentation – were conducted by the University of Nebraska at Lincoln,

using course outlines developed by Atomics International. Table I summarizes the information concerning presentation of the 14 subject areas. For more detailed information concerning the program, reference may be made to the HNPF Training Manual, NAA-SR-4775, Volumes I-IV.

Thirty CPPD personnel attended the training program. On the basis of availability and experience, these men were divided into three groups. Group I consisted of CPPD supervisors and engineers assigned to Sheldon Station. Group II and III included, primarily, the HNPF operators and technicians. In addition to the training summarized in Table I, the following CPPD personnel received extended training at Canoga Park for the lengths of time shown:

1	Plant Superintendent	1-1/2 years
2	Performance Engineers	6 weeks
1	Chemical Engineer	6 weeks
1	Health Physicist	6 weeks
1	Maintenance Supervisor	6 weeks
1	Electronics Specialist	3 weeks
3	Shift Supervisors	3 weeks

TABLE I

1960 TRAINING PROGRAM SUBJECT AREAS

Letter Designation	Subject Area	Location of Instruction	Responsible Personnel	Length of Instruction (hr)	
				Group I	Groups II & III
A	Basic Math and Physics	Lincoln	U of Neb.	None	60
B	Atomic and Nuclear Physics	Lincoln	U of Neb.	120	100
C	Basic Instrumentation	Lincoln	U of Neb.	120	120
D	HNPF Components and Fluid Systems	Lincoln	AI	60	100
E	HNPF Instrumentation and Control Systems	Lincoln	AI	60	60
F	L-77 Training	Canoga Park	AI	80	80
G	SRE Training	Canoga Park	AI	320	200
H	Safeguards and Casualty Studies	Canoga Park	AI	36	36
I	Field Trips	Canoga Park	AI	28	28
J	Health Physics	Canoga Park	AI	12	12
K	Component Handling Facilities	Canoga Park	AI	20	20
L	HNPF Electrical Systems	Canoga Park	AI	20	20
M	Review and Detailed Studies of HNPF Instrumentation	Canoga Park	AI	20	20
N	Core Loading	Canoga Park	AI	24	24
			Total	920	880

IV. 1961-1963 TRAINING AND ON-THE-JOB TRAINING

A. PROGRAM OBJECTIVE

The primary purpose of the 1961-1963 training program was to train HNPF reactor operators preparatory to their taking AEC reactor operator license examinations. This training program was of a more detailed and specific nature than was the 1960 program.

Requirements for licensed reactor operators at the HNPF are recorded in the technical specifications for the facility. The Technical Specifications for Operation at Power for Hallam Nuclear Power Facility states that:

> "One HNPF licensed operator will be in the control room when the reactor contains a critical fuel loading and the startup interlocks are energized. A second licensed operator will be on duty at the site and available to relieve the control room operator when necessary."

In order to operate the plant as described in Section II of this report, CPPD shift supervisors and unit operators should hold AEC licenses. It was considered desirable that a number of the equipment operators be trained and licensed, to provide for possible upgrading of personnel and personnel turnover. CPPD will, in the future, train its own reactor operators. Therefore, the Sheldon Station plant superintendent and professional technical staff were also included in the licensing training program.

B. DEVELOPMENT CRITERIA

The principal criteria for development of this training program was that all subject areas mentioned in the AEC operator licensing regulations, Title 10 Part 55, Code of Federal Regulations, should be thoroughly covered. Three assumptions were made concerning CPPD personnel enrolled in the program:

1) Each trainee was experienced in conventional power plant operation.

2) Each trainee was familiar with many of the features of the HNPF, as a result of his having worked at the facility for a year or more.

3) Each trainee would spend an appreciable portion of his own time studying course material and becoming familiar with equipment and facilities.

C. CPPD PARTICIPATION

Personnel who were to participate in the 1961-1963 training program had extremely varied experience and educational backgrounds. Also, the program was designed to proceed simultaneously with reactor testing. Therefore, trainees were divided into three groups and the program was carried out in three sessions. Each session covered essentially the same subject material. Certain AI employees were also required to obtain HNPF reactor operator licenses and, consequently, both AI and CPPD personnel have attended each training session. The first session was begun in September 1961 and the third session was completed in February 1963.

Thirty CPPD and 22 AI personnel were licensed by the AEC to operate the HNPF. Data concerning the CPPD personnel and their job classifications are summarized in Table II.

TABLE II

CPPD PERSONNEL TRAINED DURING THE 1961-1963 TRAINING PROGRAM

Status of Personnel	Job Description	Number of Men in Category
Trained and Licensed	Plant Superintendent	1
	Reactor Engineer	1
	Health and Safety Engineer	1
	Maintenance Supervisor	1
	Professional Engineering Staff	4
	Shift Supervisor	5
	Unit Operator	9
	Equipment Operator	8

D. PRESENTATION OF THE TRAINING PROGRAM

Training provided in each of the three sessions was as follows:

1) Scheduled Classroom Lectures

2) Training Tests

3) Homework Reading and Written Assignments

4) Scheduled Operational Training

Scheduled classes were conducted five days a week. Each class was presented twice a day in order to include all shift personnel. Each subject area was taught by an AI or CPPD instructor who was an expert in that area. Altogether, over 30 instructors were used. Lecture classes for the first training session were four hours in duration and were continued for a little over seven weeks. Total classroom lecture time for the first session was 144 hours. Classroom lectures for the second session were two hours long and were continued for 18 weeks. Total classroom lecture time for the second session was 180 hours. Classroom lectures for the third session were also of two hours duration and were continued for approximately 19 weeks. Total classroom lecture time for the third session was 192 hours. Training tests over the material covered in lectures were given on a weekly basis for the first session and on a biweekly basis for the second and third sessions. Classroom lectures for the third training session are listed in Table III. Subject material covered in the first and second sessions was quite similar to that shown in Table III with the exception that subject material in the first session was presented in a more condensed manner.

Homework reading and written assignments were made on a weekly or biweekly basis and were, to some extent, independent of the classroom lectures. Prior to each lecture, program instructors issued a subject outline and a suggested list of reference reading material. Available HNPF literature is quite plentiful. Some of the more important reference materials are:

1) Final Summary Safeguards Report for the Hallam Nuclear Power Facility, NAA-SR-5700, and its supplements

2) Technical Specifications for Operation at Power for Hallam Nuclear Power Facility

3) HNPF Training Manual, NAA-SR-4775, 4 volumes

4) HNPF Operations Manual, NAA-SR-6500, 4 volumes

5) HNPF Maintenance Manuals, NAA-SR-6502, 10 volumes

TABLE III

CLASSROOM LECTURES FOR SESSION 3 OF THE 1961-1963 TRAINING PROGRAM

Number of Lectures on Subject	Subject of Lecture	Number of Lectures on Subject	Subject of Lecture
1*	Course Introduction	3	Steam Generator, Steam and Steam Dump Systems
2	Plant Electrical System	2	Reactor Structure and Components
3	Helium and Nitrogen Systems	1	Shielding and Containment Systems
2	Fire Protection System	3	Fuel and Component Handling Systems
1	Preheat System	2	Heating and Ventilation System
2	Control Rods and Drives	1	Instrument and Service Air Systems
3	Main Sodium System and Instrumentation	2	Miscellaneous Systems
1	Na Service Systems	3	Radioactive Vent and Radioactive Liquid Handling Systems
2	Feedwater and Cooling Systems	3	Plant Protective System
3	Nuclear Instrument System	7	Plant Control System
2	Radiation Detection and Monitoring System	1	Criticality and Excess Loading Experiments
15	Nuclear Physics, Health Physics, Nuclear Engineering and Principles of Reactor Operation	1	HNPF Hazards Analysis and General Safety Procedures
1	Post Critical Testing	1	HNPF Technical Specifications
3	Plant Startup Procedures	2	Selected Sodium System SOP's
2	Selected Steam System SOP's	5	Corrective Action Procedures
1	Emergency Procedures	1	Administrative Procedures
3	Plant Shutdown Procedures	11	Training Testing

*Time for each lecture was 2 hours. Total classroom lecture time was 192 hours per trainee.

6) HNPF Preoperational Test Procedures Manual, NAA-SR-6009, 4 volumes

7) HNPF Post Critical Test Procedures, NAA-SR-6501, 2 volumes

Homework reading and written assignments covered selected material from the above and other references. These assignments were used to supplement and elaborate on training lectures and, in many cases, to cover material not covered in formalized class lectures.

Scheduled operational training consisted of actual checkout of the trainees on the plant hardware by a qualified instructor. Items such as performance of important SOP's (standard operating procedures), operation of the critical reactor, and operation of plant hardware were covered in scheduled operational training classes. These classes generally lasted a full eight-hour day. The first and second training sessions received approximately 90 and 120 hours of such instruction, respectively; the third training session received approximately 120 hours of instruction. Total instruction time for classroom lectures and operational training for the three sessions is summarized in Table IV.

TABLE IV

TRAINEE INSTRUCTION TIME FOR THE 1961-1963 TRAINING PROGRAM

Training Session	Training Time in Hours		
	Classroom Lectures	Operational Training	Total
First	144	80	224
Second	180	120	300
Third	192	120	312

E. ON-THE-JOB TRAINING

On-the-job training at the HNPF was conducted independently of the two formalized training programs. All CPPD shift operating personnel were regularly rotated between the conventional and nuclear sides of the plant on a more-or-less biweekly basis. This procedure has been practiced since the early stages of HNPF construction. All CPPD operating personnel are quite familiar

with the HNPF facility as a result of prolonged experience. With the exception of an AI shift leader, all shift personnel were supplied by CPPD. Therefore, operational activities have been performed by CPPD shift personnel throughout HNPF construction, preoperational testing, reactor startup, post critical testing, and rise-to-power testing. In addition, CPPD operational and professional personnel have been extensively used as instructors for the 1961-1963 HNPF training program, and professional personnel have served as responsible engineers for a significant portion of the HNPF testing.

V. SUMMARY

Sheldon Station employees of the Consumers Public Power District attended a formalized training program on the HNPF during 1960 while the facility was under construction. The program was conducted and developed by Atomics International and was of six months duration. Total instruction time for this program was approximately 900 hours. Thirty CPPD personnel attended.

A second HNPF training program for CPPD personnel was initiated by AI in September 1961. This program was primarily intended to train HNPF reactor operators. After completion of the training program, trainees took AEC reactor operator license examinations. The program was carried out in three sessions. The first session began in September 1961, and the third session was completed in February 1963. Thirty CPPD and 22 AI personnel were trained and, after passing the AEC examinations, received HNPF reactor operator licenses.

The two formalized HNPF training programs were entirely independent of on-the-job training activities. These activities have been extensive. The conventional portion of Sheldon Station has been a commercial power plant since July 1, 1961. All station operating personnel are thoroughly familiar with conventional power plant operation. Most operating personnel had considerable conventional power plant experience prior to employment at Sheldon Station; those who did not were trained in power plant operation by CPPD management. All shift operating personnel have been regularly rotated between conventional and nuclear sides of the facility and are, as a result of experience, familiar with both. Sheldon Station CPPD personnel were utilized extensively as instructors for the two formalized HNPF training programs and as responsible engineers for numerous tests of the HNPF. CPPD shift personnel constituted the principal operating force throughout HNPF construction, reactor startup, and testing.