ANS EQUIPMENT DATA BASE

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INTRODUCTION

The Advanced Neutron Source (ANS) is a new experimental facility planned to meet the national need for an intense, steady-state source of neutrons. It will be open for use by scientists from universities, industry, and other federal laboratories. The ANS will be equipped with an initial complement of advanced instruments for neutron scattering and nuclear physics research, with facilities for isotope production and for the study of materials in high radiation fields.

The primary objectives in the design of the ANS site and buildings are to provide a protective containment structure for the reactor; to provide the optimal facilities for utilization of neutron beams and irradiation facilities; and to address the mix of needs associated with the user community, operations staff, security, containment control, and noise.

These objectives will be met with a four-building concept (see Fig. 1). The central structure is a 60-m (~200-ft) diam cylindrical, domed reactor building. This building will house the reactor itself, with its lower floors dedicated to beam and irradiation experiments and with a high-bay floor dedicated to reactor operations. A reactor support building, to be adjacent to the reactor building, will house other large reactor equipment and the general support equipment not located in the reactor building. The primary heat exchangers and circulating pumps will be located in cell banks within reactor containment. The guide hall building, connected to the reactor dome outside reactor containment, is dedicated to beam experiment use. The fourth building will be an office building serving both the extensive user community and the reactor operations staff.

These buildings will contain many of the systems needed for operation of the ANS and will be comprised of equipment requiring specification of performance, test, and operating parameters. The number of equipment items, the possibility for multiple application of a particular piece of equipment, and the need for a single source of information for all equipment led to a requirement to develop an equipment-related data base.
OBJECTIVE

My assignment on the ANS Project was to create the framework for an information data base to identify all the major ANS equipment, along with the major characteristics of each piece of equipment, so that specific characteristics could be organized and retrieved on demand. Using this data base, any user would be assured of access to the most up-to-date equipment information and to retrieval of specific data. Since the project design has only limited definition of the balance-of-plant systems, development of the data base has focused on the reactor cooling system equipment. The data base will include the flexibility for expansion as the ANS design progresses. This data base will also serve as a guide to engineers of equipment requirements to be considered in specifying hardware requirements for the ANS Project components.

BACKGROUND

The equipment data base is structured as a multi-page layout for each equipment item. This layout is formatted to cover everything from the item's operating environment to its unit cost. It provides a comprehensive listing of possible equipment requirements based on criteria such as equipment description, power conditions, system description, quality assurance testing, and vendor qualities. The data base also identifies equipment by its specific location. The first page of a record for a single piece of equipment is shown in Exhibit 1.

APPROACH

In order to create the data base, a general knowledge of the reactor's mechanical systems and the overall characteristics of the remaining ANS systems was needed. [The data base was based on the design of the reactor cooling system (see Fig. 2), since this was the system that was most developed.] Several documents were reviewed to become familiar with terminology and system characteristics. Using information from the ANS Project Nuclear Energy/Energy Research (NE/ER) Review (May 8-10, 1990), the objectives and function, major equipment, and features and schematic arrangement of the various systems were developed.
Exhibit 1. Sample Data Base Characteristics

**EQUIPMENT DESCRIPTION**

**EQUIPMENT NAME** PRIMARY COOLANT PUMP

**EQUIPMENT NUMBER** RWS-PU-1A

**EQUIPMENT FUNCTION** CIRCULATES REACTOR COOLING WATER

**EQUIPMENT TYPE** DYNAMIC, CENTRIFUGAL, VERTICAL SHAFT CIRCULATING

**NORMAL OPER. COND.**

**EMERGENCY OPER. COND.**

**RATED OPER. COND.**

**FLUID ALLOCATION**

**FLUID NAME** HEAVY WATER

**VIBRATION ISOLATION**

**MAX. TEMP.** 150 C

**MIN. TEMP.** 20 C

**MAX. PRESSURE** 200 KPA AT 10 METER HEAD

**MIN. PRESSURE**

**MAX. VOLUME** 27,000 L/S

**MAX. VELOCITY**

**MIN. VELOCITY**

**FLOW RATE** 550 M/S

**TOP LEVEL REQUIREMENTS** NRC 10 CFR50

**CODE CLASS** ASME SECTION 3 CLASS 1

**SAFETY CLASS** CLASS 1

**SEISMIC CLASS** CLASS 1

**CLEANLINESS CLASS** CLASS 2

**QA CLASS** CLASS 1

**TEMA CLASS**
Fig. 2. Reactor cooling system flowheet.
In addition to the NE/ER Review, data from the Clinch River Breeder Reactor Plant Project Status and Control Systems Description Manual provided needed information and familiarization with plant and reactor terminology and definitions. This report also provided a data elements definition summary, which identified information that could be included in a data base. This summary defined data base fields and provided a sample input on how the CRBR project defined several example identification numbers for use in a data base (see Table 1). The major impact of this document was its emphasis on organizing data base fields to describe specific items of equipment.

Information from the Operating Manual for the High Flux Isotope Reactor (HFIR) also proved to be valuable because of the similarities between the HFIR and the ANS reactors. These similarities included the areas of reactor systems and equipment operation related to the primary and secondary cooling systems that have certain general operating parameters and requirements similar to the ANS. Although specific information concerning design requirements such as reactor inlet pressure and reactor operating temperatures was available, such information from the HFIR had to be scaled to be consistent with the ANS system requirements. In addition to system parameters, the HFIR manual provided information about the HFIR reactor cooling system.

In addition, access to equipment lists from the Conceptual Design Report for Environmental and Molecular Sciences Laboratory gave practical insight on the requirements and characteristics that data bases need to represent. Considering the different natures of laboratory and reactor equipment, specific information related to the HFIR was not applicable for an equipment data base for the ANS, but the basic requirements tabulations were useful.

FEATURES OF THE ANS EQUIPMENT DATA BASE

The first step in actually creating the equipment data base was to learn how to use and operate the Claris FileMaker II data base program on an Apple Macintosh personal computer (Mac II). The FileMaker II software and the Mac II were chosen to be compatible with another ANS Project data base on site and facility requirements. Because they were easily learned, minimum time was spent learning the program, allowing more time to be spent on the data base development. The data base is structured to store, organize, and synthesize the different kinds of track equipment

*Claris Corporation, Mountain View, California
Table 1. Sample data from Clinch River Breeder Reactor Project (CRBRP) description manual

1. **Equipment Identification Number (EIN)** - a nine-digit alpha-numeric identifier which uniquely identifies each component in the plant.

2. **Equipment Title** - a twenty-five field description of the equipment.

3. **Building Identification Code** - a three-digit code which identifies the building in which the equipment is located.

4. **Room/Cell** - a five-digit alpha-numeric number identifying the location of the equipment; either room or cell.

5. **Elevation** - a three-digit number identifying in feet the plant elevation at which the equipment is located.

6. **Procurement Responsibility** - a one-digit number identifying the organization which has procurement responsibility for the equipment.
requirements, but it will also provide users with the ability to arrange that information so that it is most useful for their work. A thorough understanding of the program is essential to the preparation of the data base, but it is not difficult to master. The FileMaker II software manual gives a complete description of data base operation and will not be duplicated here.

The next step was to brainstorm about a comprehensive listing of requirements and characteristics concerning equipment items. Using information from the ANS review, HFIR, and the Environmental and Molecular Science Laboratory, fields and categories of equipment requirements were selected and organized. For instance, the initial fields, which are the specific characteristics of the equipment, were broken down into several broad areas. These areas, which could be generally applied to all equipment, were equipment identification, general descriptions and specifications, environmental operating conditions, process operating conditions, vendor information, equipment service, applicable codes and regulations, maintenance, and tests. These categories were later altered and revised as actual equipment items were examined. It is important to note that at this point in the development of the data base, specific inputs were intended to be only representative of actual data that would ultimately be incorporated into the data base. Once this working data base was established, actual information based on the reactor primary-coolant-system pumps was input to test the basic data base using these reactor cooling pumps as an example of an equipment item. The pump features were input to five broad areas: general description, power conditions, description of system, quality assurance testing, and vendor information. Other data added as the data base developed were included under one of these categories. Based on this five-part general approach, the data base was expanded and tested to include fields which would apply not only to pumps but also to the primary heat exchangers (See Appendix A). The differences in these items were an indication of difficulties encountered in trying to create fields that would encompass both. As fields continued to be developed, applications beyond these initial test examples were added to the data base, and fields were expanded as required to accommodate valves, tanks, vents, and strainers. Fields have been included that apply not only to these items but to the reactor equipment listed below:

- primary coolant pump
- main heat exchanger
- emergency heat exchanger
- loop isolation valve
- containment isolation valves
- pressurizer pump
- letdown tank
- shutdown emergency coolant pump
- refueling machine
- reflector tank
- primary flowmeter
- reactor cooling tower
- vent
- strainer
- heavy water exchanger
- letdown valve
RELATIONSHIP TO PROJECT

The equipment data base developed for the ANS Project will provide a valuable asset to the project. It will give users an up-to-date summary of any particular piece of equipment and its characteristics as specified for use on the ANS Project. Although equipment lists are provided on most projects, a data base provides information in greater detail as it can be accessed by a particular engineer for specific data items. For example, an electrical engineer might develop a complete equipment list that outlines the equipment description, power conditions, system description, quality assurance testing features, and vendor information, but viewing this complete file would be cumbersome since all that might be needed are simply the power conditions of the equipment. Therefore, a useful feature of this data base is the capability to select specific categories of information, e.g., a list of all the power conditions of each equipment item. This capability of the data base will enable users to obtain specific data without hassle or delay. Another example would be an engineering designer who is not concerned with the power conditions but who requires data related to the tests performed on this particular piece of equipment. In this case, the user is able to select only the relevant information concerning quality assurance data (See Exhibit 2).

The data base concept will also facilitate keeping the information up-to-date. As information changes, users can key into the data base to determine the most recent issue of a particular parameter or equipment item and update the information or verify its accuracy. Although the ability to select only portions of all the data available is not unique to this data base, the software employed will allow a great deal of flexibility as the design progresses and the equipment list grows.

One of the most interesting things about data bases in general is their usefulness to such a wide variety of people. All types of people specializing in different areas share a common need for the information contained in a data base. Another feature is its ability for use with other data bases. The ANS equipment data base has a direct relationship with the facility criteria data base created by H. B. Shapira. Using a location identifier that is common to both, the facility requirements can be evaluated and developed based on equipment requirements.
## Exhibit 2. Quality Assurance Features of Data Base

<table>
<thead>
<tr>
<th>EQUIPMENT NAME</th>
<th>PRIMARY COOLANT PUMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQUIPMENT NUMBER</td>
<td>RWS-PU-1A</td>
</tr>
<tr>
<td>SPECIFICATION NUMBER</td>
<td>TEMPERATURE MEASUREMENT SYS. TEST / RADIATION MEASUREMENT SYS. TEST / PRESSURE SWITCH TEST</td>
</tr>
<tr>
<td>TESTS BY VENDOR</td>
<td>PRESSURE SWITCH TEST / TEMPERATURE MEASUREMENT SYS. TEST</td>
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<tr>
<td>TESTS BY COMPANY</td>
<td>565565656565</td>
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<table>
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<tr>
<th>EQUIPMENT NAME</th>
<th>PRIMARY HEAT EXCHANGER</th>
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<tr>
<td>EQUIPMENT NUMBER</td>
<td>Q - 2734 - 1A</td>
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<tr>
<td>SPECIFICATION NUMBER</td>
<td>TEMPERATURE MEASUREMENT SYS. TEST / PRESSURE SWITCH TEST / RADIATION MEASUREMENT SYS. TEST</td>
</tr>
<tr>
<td>TESTS BY VENDOR</td>
<td>PRESSURE SWITCH TEST / FLOW MEASUREMENT SYS. TEST / RATE TEST</td>
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<tr>
<td>TESTS BY COMPANY</td>
<td>1234454-76666</td>
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RECOMMENDATIONS

Currently, the data base is essentially a formatted structure because of the limited amount of data actually incorporated into the program; however, several suggestions and recommendations can be made concerning the progression and future development of the equipment data base. Several sample data sheets on pumps, valves, and tanks were only recently received and have not yet been included in the data base. Development of new fields for these equipment items would be a logical next step. For pumps, the addition of maximum capacity, suction head, and static head would be appropriate and could perhaps fall under the category of equipment description for future fields. Characteristics such as pump power, driver power, and rotational speed could be included under power conditions. Since there are many characteristics associated with an equipment item that need not be included in a data base, a careful review of all information is required to incorporate only useful data. The intent is to not clutter the data base with nonessential information. More detailed data such as serial number, manufacturer's model number, and general calculations would fall under vendor information. For valves, perhaps an entirely new category called service conditions may need to be added. These conditions would include such items as flow medium, operating temperature, radiation level, and flow coefficient. If the service conditions portion of this data base did not apply to any equipment except valves, then perhaps a totally separate data base could be created for valves and other similar components. At this stage in the development of the data base, additional equipment should be included to test the concept before it is implemented project-wide.

As time goes on and as more information is identified, the data base should be expanded to incorporate the equipment in each of the remaining reactor and balance-of-plant systems.

The data base is currently on a file called ANS Data Base. For further information, contact R. A. Brown, telephone (615) 576-5512, FEDC, MS-8218.
References


Appendix A
ANS Equipment Data Base

EQUIPMENT DESCRIPTION

EQUIPMENT NAME: PRIMARY COOLANT PUMP
EQUIPMENT NUMBER: RWS-PU-1A
EQUIPMENT FUNCTION: CIRCULATES REACTOR COOLING WATER
EQUIPMENT TYPE: DYNAMIC, CENTRIFUGAL, VERTICAL SHAFT CIRCULATING

NORMAL OPER. COND.

EMERGENCY OPER. COND.

RATED OPER. COND.

FLUID ALLOCATION

FLUID NAME: HEAVY WATER

VIBRATION ISOLATION

MAX. TEMP.: 150 C
MIN. TEMP.: 20 C
MAX. PRESSURE: 200 KPA AT 10 METER HEAD
MIN. PRESSURE
MAX. VOLUME: 27,000 L/S
MAX. VELOCITY
MIN. VELOCITY

FLOW RATE: 550 M/S

TOP LEVEL REQUIREMENTS

NRC 10 CFR50

CODE CLASS: ASME SECTION 3 CLASS 1
SAFETY CLASS: CLASS 1
SEISMIC CLASS: CLASS 1
CLEANLINESS CLASS: CLASS 2
QA CLASS: CLASS 1
TEMA CLASS
Appendix A
ANS Equipment Data Base
(continued)

APPROX. SIZE 0.5 M SUCTION

APPROX WEIGHT 6000 KG INCLUDING MOTOR

EQUIPMENT LOCATION 1.509C - CONTAINMENT

SERVICE LIFE 5 YEARS

POWER CONDITIONS

POWER SOURCE ELECTRIC MOTOR

ELECTRICAL LOAD 7400 KW

POWER CLASS CLASS 1E

LOAD VOLTAGE/CURRENT 2400 VAC/1800 A / 3 PHASE

EFFICIENCY 90 %

RATED HORSEPOWER 2200

SYSTEM DESCRIPTION

SYSTEM NAME PRIMARY COOLING SYSTEM

NORMAL OPER. ENVIR. AIR

EMERGENCY OPER. ENVIR. SUBMERGED IN WATER / HIGH TEMPERATURE

RADIATION AREA RESTRICTED

RADIATION SOURCE N16

QUALITY ASSURANCE TESTING

TESTS BY VENDOR TEMPERATURE MEASUREMENT SYS. TEST / RADIATION MEASUREMENT SYS. TEST / PRESSURE SWITCH TEST
TESTS BY COMPANY  PRESSURE SWITCH TEST / TEMPERATURE

SPECIFICATION NUMBER  5656565656

VENDOR INFORMATION

MANUFACTURER  BW/IP INTERNATIONAL, INC.

QUANTITY  4

COST  $5000 EACH

RESP. ENGR. DESIGNER  K.W. WILCHER

PARTS LIST

DATE MODIFIED  7/12/90

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Appendix A
ANS Equipment Data Base
(continued)

EQUIPMENT DESCRIPTION

PRIMARY HEAT EXCHANGER

EQUIPMENT NAME

EQUIPMENT NUMBER  Q - 2734 - 1A

EQUIPMENT FUNCTION

EQUIPMENT TYPE  BGM HOR CONNECTED IN 3 PARALLEL 1 SERIES / NESTED

NORMAL OPER. COND.

EMERGENCY OPER. COND.

RATED OPER. COND.

FLOW ALLOCATION

FLUID NAME  SHELL SIDE:FS/D2O --- TUBE SIDE:FT/ H2O

VIBRATION ISOLATION

MAX. TEMP.  (IN/OUT) SHELL SIDE:(175/120) - TUBE SIDE:(85/115)

MIN. TEMP.

MAX. PRESSURE  SHELL SIDE: 305 PSIA - TUBE SIDE:75 PSIA

MIN. PRESSURE

MAX. VOLUME

MAX. VELOCITY

MIN. VELOCITY

FLOW RATE  1/3 FLOW PER EXCHANGER

TOP LEVEL REQUIREMENTS  NRC 10 CFR50

CODE CLASS  ASME CODE SEC 8 DIV 1

SAFETY CLASS  CLASS 1

SEISMIC CLASS  CLASS 2

CLEANLINESS CLASS  CLASS 1

QA CLASS  3

TEMA CLASS  R
Appendix A
ANS Equipment Data Base
(continued)

APPROX. SIZE 86-360

APPROX WEIGHT 187568 LB SHELL - 286454 LB FILLED WITH WATER

EQUIPMENT LOCATION 1.509C - REACTOR CONTAINMENT BUILDING

SERVICE LIFE 5 YRS

POWER CONDITIONS

POWER SOURCE ELECTRICAL LOAD

POWER CLASS

LOAD VOLTAGE/CURRENT

EFFICIENCY

RATED HORSEPOWER

OTHER

SYSTEM DESCRIPTION

SYSTEM NAME PRIMARY COOLANT SYSTEM

NORMAL OPER. ENVIR. AIR

EMERGENCY OPER. ENVIR. SUBMERGED IN WATER / HIGH TEMPERATURE

RADIATION AREA RESTRICTED

RADIATION SOURCE N16

QUALITY ASSURANCE TESTING

TESTS BY VENDOR TEMPERATURE MEASUREMENT SYS. TEST / PRESSURE SWITCH TEST / RADIATION MEASUREMENT SYS. TEST
TESTS BY COMPANY
PRESSURE SWITCH TEST / FLOW MEASUREMENT SYS.

SPECIFICATION NUMBER
123454-76666

VENDOR INFORMATION
MANUFACTURER
JOSEPH OAT CORPORATION

QUANTITY
5

COST
920,000 PER SHELL

RESP. ENGR. DESIGNER
K.L. WILCHER

PARTS LIST

DATE MODIFIED
7/18/90

BY
DERRICK COFFIN
### Equipment Description

**Loop Isolation Valve**

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<td>TEMA Class</td>
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APPENDIX A
ANS Equipment Data Base
(continued)

APPROX. SIZE 14"

APPROX WEIGHT

EQUIPMENT LOCATION 1.509C - CONTAINMENT

SERVICE LIFE 10 YEARS

POWER CONDITIONS

POWER SOURCE ELECTRIC MOTOR

ELECTRICAL LOAD 440 VAC

POWER CLASS NON DIVISIONAL

LOAD VOLTAGE/CURRENT

EFFICIENCY 90%

RATED HORSEPOWER 1/2 HP

OTHER

SYSTEM DESCRIPTION

SYSTEM NAME REACTOR PRIMARY COOLING SYSTEM

NORMAL OPER. ENVIR.

EMERGENCY OPER. ENVIR.

RADIATION AREA RESTRICTED

RADIATION SOURCE

QUALITY ASSURANCE TESTING

TESTS BY VENDOR PRESSURE SWITCH TEST / RADIATION MEASUREMENT SYS. TEST
Appendix A
ANS Equipment Data Base
(continued)

TESTS BY COMPANY  FLOW MEASUREMENT SYS. TEST / RADIATION

SPECIFICATION NUMBER  565565

VENDOR INFORMATION

MANUFACTURER

QUANTITY

COST  900,000 PER VALVE

RESP. ENGR. DESIGNER  K.W. WILCHER

PARTS LIST

DATE MODIFIED  7/20/90

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