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Accession #: D196023638

Document #: SD-SNF-SDD-005

Title/Desc:

SYSTEM DESIGN DESCRIPTION FOR SAMPLING FUEL IN K  
BASINS

Pages: 45

FEB 09 1996

## ENGINEERING DATA TRANSMITTAL

1. EDT

Page 1 of 1  
610195

|   |  |   |
|---|--|---|
| 2. To: (Receiving Organization)<br>Distribution   | 3. From: (Originating Organization)<br>Spent Nuclear Fuel<br>Evaluations 8M710 | 4. Related EDT No.:                             |
| 5. Proj./Prog./Dept./Div.:<br>SNFP  | 6. Cog. Engr.:<br>R.B. Baker   | 7. Purchase Order No.:<br>N/A                   |
| 8. Originator Remarks:<br>For Release -- SYSTEM DESIGN DESCRIPTION FOR SAMPLING FUEL<br>IN K BASINS |  | 9. Equip./Component No.:<br>N/A                 |
| 11. Receiver Remarks:   |  | 10. System/Bldg./Facility:<br>105-K Basins/100K |
|   |  | 12. Major Assm. Dwg. No.:<br>N/A                |
|   |  | 13. Permit/Permit Application No.:<br>N/A       |
|   |  | 14. Required Response Date:                     |

| 15. DATA TRANSMITTED |                          |                     |                    |  | (F)                         | (G)                               | (H)                                 | (I)                               |
|----------------------|--------------------------|---------------------|--------------------|--|-----------------------------|-----------------------------------|-------------------------------------|-----------------------------------|
| (A)<br>Item<br>No.   | (B) Document/Drawing No. | (C)<br>Sheet<br>No. | (D)<br>Rev.<br>No. | (E) Title or Description of Data<br>Transmitted                  | Approval<br>Desig-<br>nator | Reason<br>for<br>Trans-<br>mittal | Orig-<br>inator<br>Dispo-<br>sition | Receiv-<br>er<br>Dispo-<br>sition |
| 1                    | WHC-SD-SNF-SDD-005       |                     | 0                  | SYSTEM DESIGN<br>DESCRIPTION FOR<br>SAMPLING FUEL IN<br>K BASINS | N/A                         | 1,2                               | 1                                   |                                   |
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|   |       |                            |                                     |  |                         |  |               |          |          |        |       |
|---|-------|----------------------------|-------------------------------------|--|-------------------------|--|---------------|----------|----------|--------|-------|
| 16. KEY   |       |                            |                                     |  |                         |  |               |          |          |        |       |
| Approval Designator (F)   |       | Reason for Transmittal (G) |                                     |  |                         | Disposition (H) & (I)  |               |          |          |        |       |
| E. S. O, D or N/A<br>(see WHC-CM-3-5,<br>Sec.12.7)  |       | 1. Approval                | 4. Review                           | 1. Approved  | 4. Reviewed no/comment  |  |               |          |          |        |       |
|   |       | 2. Release                 | 5. Post-Review                      | 2. Approved w/comment  | 5. Reviewed w/comment   |  |               |          |          |        |       |
|   |       | 3. Information             | 6. Dist. (Receipt Acknow. Required) | 3. Disapproved w/comment                                     | 6. Receipt acknowledged |  |               |          |          |        |       |
| 17. SIGNATURE/DISTRIBUTION<br>(See Approval Designator for required signatures)             |       |                            |                                     |  |                         |  |               | (G)      | (H)      |        |       |
| Reason  | Disp. | (J) Name                   | (K) Signature                       | (L) Date   | (M) MSIN                | (J) Name   | (K) Signature | (L) Date | (M) MSIN | Reason | Disp. |
| 1   | 1     | Cog. Eng. R.B. Baker       | R.B. Baker                          | 1/18/96  | X0-40                   | M.J. Langevin  | M.J. Langevin | 1/18/96  | X3-74    | 1      | 1     |
| 1   | 1     | Cog. Mgr. R.P. Omberg      | R.P. Omberg                         | 1/18/96  | R3-85                   | D.W. Bergmann  | D.W. Bergmann | 1/18/96  | R3-86    | 1      | 1     |
| 1   | 1     | QA G.M. Davis              | G.M. Davis                          | 1/18/96  | X3-80                   |  |               |          |          |        |       |
| 1   | 1     | Safety D.O. Hess           | D.O. Hess                           | 1/18/96  | X3-80                   |  |               |          |          |        |       |
|   |       | Env.                       |                                     |  |                         |  |               |          |          |        |       |
| 1   |       | C. Deighan-Price           | C. Deighan-Price                    | 1/18/96  | X3-79                   |  |               |          |          |        |       |
| 1   |       | C.T. Miller                | C.T. Miller                         | 1/18/96  | X3-72                   |  |               |          |          |        |       |
| 18.   |       | 19.                        |                                     | 20.  |                         | 21. DOE APPROVAL (if required)   |               |          |          |        |       |
|  1/18/96 |       |                            |                                     |  |                         | Ctrl. No.  |               |          |          |        |       |
| Signature of EDT<br>Originator  |       | Date                       |                                     | Authorized Representative Date<br>for Receiving Organization |                         | <input type="checkbox"/> Approved<br><input type="checkbox"/> Approved w/comments<br><input type="checkbox"/> Disapproved w/comments |               |          |          |        |       |
|   |       |                            |                                     |  |                         |  |               |          |          |        |       |

## SYSTEM DESIGN DESCRIPTION FOR SAMPLING FUEL IN K BASINS

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U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 610195      UC: 2070  
Org Code: 8M710      Charge Code: LB029  
B&R Code: EW 3135040      Total Pages: 41

Key Words: K Basins, Sampling Equipment, Fuel Characterizaton, System Design Description, and Spent Nuclear Fuel Project

Abstract: This System Design Description provides: (1) statements of the Spent Nuclear Fuel Projects (SNFP) needs requiring sampling of fuel in the K East and K West Basins, (2) the sampling equipment functions and requirements, (3) a general work plan and the design logic being followed to develop the equipment, and (4) a summary description of the design for the sampling equipment. The report summarizes the integrated application of both the subject equipment and the canister sludge sampler in near-term characterization campaigns at K Basins.

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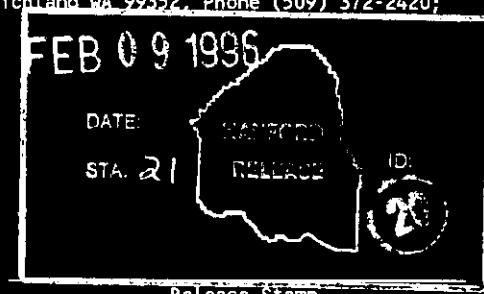
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*Jamie Winkler 2-9-95*

Release Approval

Date



Approved for Public Release

**WHC-SD-SNF-SDD-005, REV. 0**

**SYSTEM DESIGN DESCRIPTION FOR  
SAMPLING FUEL IN K BASINS**

January 10, 1996

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**WHC-SD-SNF-SDD-005, REV. 0**

**SYSTEM DESIGN DESCRIPTION FOR  
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## SYSTEM DESIGN DESCRIPTION FOR SAMPLING FUEL IN K BASINS

### 1.0 INTRODUCTION

A number of key activities underway as part of the Spent Nuclear Fuels Project (SNFP) are related to the processing and disposing of spent nuclear fuel (SNF) from the 105-K Basins (K Basins). The proposed "Path Forward" (Reference 1) disposition of SNF is summarized in Figure 1 along with estimates of the quantities involved. Development of SNF recovery equipment, processing equipment, transport methods, and disposal options all require specific SNF characterization data.

While some data on SNF have been obtained, recent studies conclude there is less data than needed for project decisions and equipment design bases. Additional quality data are required and will be defined through the process of developing Data Quality Objectives (DQO) and Sample Analyses Plans (SAP). Because of the requirements for characterizing SNF in both K East and K West Basins, the SNF sampling system is being developed to be used as a routine process run by Basin Operations. Application of the system will be under the cognizance of the Spent Nuclear Fuel Evaluations group who is tasked to provide characterization data for the SNFP.

Taking SNF samples is a comparatively simple task by Basin Operations standards and is basically considered an activity rather than a project. Based on discussions with Operations staff, a graded approach is being used for the requirements for K Basin reviews as defined in the draft "K Basin Plant Project Review Guidelines" (Reference 2). Responding to this, this system design description (SDD) document addresses several documentation needs including: (1) statements of the SNFP needs requiring this sampling, (2) system functions and requirements, (3) a general work plan and design logic being followed, and (4) a summary design description of the primary system including process flow. This SDD provides an integrated package for use with K Basin staff and for interfacing with the design and support team.

## 1.1 DEFINITIONS

**Fuel samples** Selected fuel elements and parts that will be shipped to the 327 Building (hot cells) for examination.

## 1.2 PROJECT BASIS OF NEED FOR SAMPLING SYSTEM

The system and equipment that is the subject of the SDD will be used to sample and ship spent nuclear fuel elements, broken fuel parts, and canister sludge to the 327 Building for examination. This activity is an integral part of the current SNFP characterization program plan (Reference 3), which responded to the accelerated Path Forward Memorandum of Agreement (Reference 4).

## 2.0 FUNCTIONS AND REQUIREMENTS

### 2.1 FUNCTIONS

The system will provide the capability to safely and efficiently sample SNF from open and closed canisters located in the K Basins. Included in the system are the tools to decap selected closed canisters in KW basin, remove selected fuel and sludge samples from open KE and KW canisters, and to load the samples into an appropriate cask for delivery to the 327 Building for required analysis and characterization and to recap. Also included in the system are tools to draw gas and liquid samples from closed KW canisters in the KW Basin without decapping.

The system will reliably provide fuel samples consistent with the DQO and SAP, will maintain traceability, and will minimize potential contamination in the K Basins and transportation path to the 327 Building.

The system will incorporate as many proven design features as possible from past fuel and sludge sampling experience and will incorporate features to eliminate or reduce previously encountered problems.

### 2.2 REQUIREMENTS

The following summarize the system requirements:

- A. The system shall provide the capability to deliver batches of fuel and canister sludge samples to the 327 Building in batches of up to six fuel assemblies.
- B. The system shall operate with present utilities available in the K East and K West Basin areas, and be able to operate with the existing physical environment (e.g., from existing grating, within overhead obstructions, weight restrictions, air quality, etc.) and the K Basin Safety Analysis Report (SAR).
- C. Interfaces of support services (e.g., mobile laboratory), transportation (e.g., PAS-1 cask, CNS 1-136 cask), and laboratory handling (e.g., 222S, 327 Building) shall be fully defined and integrated in the system planning. Interface limits (e.g., dose rate, size, etc.) in each case shall be fully integrated. [This SDD does not cover the cask system. The cask system will be designed to

interface with the acceptance criteria of the laboratory facilities chosen.]

- D. The system shall be designed for routine use by K Basin Operations staff. System controls and handling will account for the encumbrances on the operators wearing the levels of protective clothing needed in K East and K West.
- E. The system and its operation will minimize waste and consider ease of disposal of waste throughout its life cycle (i.e., fabrication, operation, storage and final disposal of equipment).
- F. The system shall limit the amount of water added to either the KE or KW Basin during Phase II fuel sampling to 2000 gallons.
- G. The system shall limit personnel exposure to five (5) person-rems for the entire gas/liquid, canister sludge, and fuel sampling campaign.
- H. The system shall not require more than three (3) operators at any one time during fuel sampling and while preparing it for shipment.
- I. Hydrogen generation from fuel and sludge samples shall not exceed limits defined in the Safety Evaluation for Packaging (SEP) for the CNS cask (Reference 5).

### 3.0 GENERAL WORKPLAN AND K BASIN PLANT INTERFACES

Figure 2 describes the general design sequence for the SNF sampling system equipment. Basically, equipment development will follow from the functions and requirements described in the previous sections. The cold test basin in the Hanford 305 Building will be used as a key for assuring performance of the equipment (as much as possible through cold testing) and minimizing dose to operators and developers. The cold test facility will be used for feature testing (e.g., independent testing of design features), design refinement, acceptance testing (i.e., final cold testing of the integrated system design with simulation), and cold training the K Basin operators. Further validation of the operators will follow in the K West Basin to minimize dose (versus a dry run in K East) while allowing final validation of the design in the actual environment of the Basin facilities.

Parallel to the development of the equipment will be development of the readiness process, using a graded approach for readiness as per RL directive 5480.31. Readiness documents (i.e., readiness checklist, workplan, procedures, etc.,) and safety reviews (i.e., hazards category, unreviewed safety questions, evaluations, etc.) for the sampling run will be developed.

The interface and reviews between the design process of the equipment and the K Basin Operations Plant staff is summarized in Table 2. This is based directly on Reference 2 recommendations, assuming a graded approach -- combining related steps where feasible to simplify the effort which is for a comparatively simple system. An example of this is the use of this SDD to provide four of the primary initial documents (e.g., documenting the SNF need, the functions and requirement, general workplan, and preliminary design summary). Also, see Section 1.0 for detail on SDD purpose. This interface approach was reviewed with key K Basin staff and should provide sufficient depth for the task involved. The Point of Contact (POC) will be continually advised on the design development steps as they occur.

Figure 3 shows the present work breakdown for development and first application of the SNF sampling system. Table 1 provides the primary documents, authors, and approving organizations. Table 2 provides a summary of primary design areas and responsibilities. Because the first sampling is viewed as a high priority for input to process equipment design, the schedule for this sampling equipment makes use of as many parallel activities and past design work as reasonable. Sound engineering, safety, ALARA, data quality, and K Basin Operation requirements, however, require a set of steps that cannot be short cut if the sampling is to be successful.

Since the sampling systems are to be run by Operations, training of the operators is an important ingredient to success. This will be accomplished through (1) initial interface meetings on the equipment as it is designed and developed, (2) cold training in the Hanford 305 Building with the operators using the final equipment, and (3) a dry run made in the K West Basin. Significant periods are allotted to these tasks to help assure the final application is successful with minimum dose.

The system and equipment for sampling canister sludge is described in Reference 6. The process and equipment are also described in this SDD to the extent necessary to integrate and show the relationships and interfaces between fuel sampling and canister sludge sampling.

## 4.0 SYSTEM DESIGN DESCRIPTION

The design of the sampling system is based in large part on concepts and equipment used in the 1994-95 fuel and sludge sampling campaigns. This system is designed to process SNF stored at KE Basin in open canisters and SNF stored at KW Basin in closed MkI and MkII canisters.

- The KE canisters are open at the top, allowing fuel to be removed out of the top of the canister.
- The KW MkI canisters are encapsulated using a piston-shaped lid with a Grafoil compression ring inserted into the top of the canister during initial encapsulation. The canister needs to be internally pressurized to drive out the lid and to allow fuel and sludge samples to be obtained from the top of the canister.
- The KW MkII canisters are encapsulated using an external cover secured with a locking bar. The locking bar is turned to remove the can and allow removal of fuel and sludge samples from the top of the canister.

The closed MkI and MkII canisters are provided with two external vent valves: one located in the center of the lid, the other on the outer periphery of the lid. The center valve has a tube that extends vertically down into the canister. The outer valve opening into the canister is flush with the inside of the lid. These two valves provide the capability to purge and fill the top two inches of the barrel with an inert gas when initially capping or recapping a canister, isolating a canister from the basin water. These two valves are also utilized to vent and completely fill the canister with water and to take gas and liquid samples.

As a result of the above differences, the equipment needed to sample SNF varies with type of canister. The equipment and their functions are summarized in Table 3 and are described below. Minimum handling time is desired to maintain low worker dose rates. Materials used for construction of the equipment shall be compatible with the basin water and the radioactive gas, liquid, and fuel in the canisters. Unless otherwise noted, the equipment functions at the canister interface but is manually operated from locations above the basin grating.

Gas and Liquid Sampler The function of the gas and liquid sampler is to sample the gas and/or liquid content of a closed MkI or MkII canister barrel. Access to the liquid contents inside the canister is through the center vent valve. Access to the gas contents inside the canister is through the side valve.

The sampler shall be designed to draw 10 to 20 ml of gas or liquid samples from a canister. The sampler equipment must be capable of opening the center vent valve, drawing a sample, and closing the vent valve. The equipment shall not cause excessive sample dilution by basin water or cross contamination of samples.

Valve Stem Handling Tool The function of this equipment is to remove the center vent valve from MkI canister lids. The design of this equipment is shown in Drawing H-1-81198.

Tube Crimping Tool The function of this equipment is to effectively close off the tube connecting the MkI canister barrel gas space to the gas trap. The equipment does not have to completely close the flow path. However, the flow path must be sufficiently restricted so as not to significantly diminish the capability of the Pressure System to pressurize the canister and displace the lid. However, the leak path should not contribute significantly to water addition to the basin. The design of this tool is shown in Drawing H-1-81202.

Nut Handling Tool The function of this tool is to loosen MkI lid nuts during lid removal and to tighten the nuts during lid replacement. The equipment shall be designed to allow tightening to a torque of 30 ft-lbs. The design of this equipment is shown in Drawing H-1-81199.

Pressure System The function of this equipment is to apply water pressure to the inside of MkI canisters via the center vent valve to gradually push the lid out of the canister. The equipment shall be designed to limit water pressure inside the canister to 120 psig. The design of this equipment is shown in Drawings H-1-81200 and H-1-81204.

Lid Handling Tool The function of this equipment is to pick up MkI lids during lid removal and move them to another location in the basin and to insert new lids into the canister during recapping operations. The equipment shall limit insertions of the replacement lid so that the top of the lid is flush with the top of the canister cylinder. The design of the MkI lid handling tool is shown in Drawing H-1-81197.

Fuel Removal Tool This equipment is used to grapple and remove selected inner and outer fuel elements from canisters and place them in sample containers. The equipment shall prevent fuel from being lifted to within 10 feet of the surface of the basin water.

Fuel Canister Manual Valve Operator This equipment is used with MkI and MkII canisters to (1) open and close the center and outer vent valves, (2) add water and corrosion inhibitor to recapped canisters, and (3) reestablish an inert gas space in the top of the canisters.

Single Element Fuel Containers (SEFC) This equipment is used to contain individual fuel samples taken out of the storage canisters. The containers shall be cylindrical and of sufficient diameter and length to hold an assembled inner and outer fuel element. One end shall be closed, the other end equipped with a removable, leak tight lid. The containers shall be capable of handling an internal pressure of 50 psig. The lid shall be provided with a small valve connection to permit hydrogen testing.

Hydrogen Tester This equipment will be used to measure the rate of hydrogen generation by measuring the rate of gas generation in the SEFC while it is stored near the bottom of the basin.

Cask Insert This equipment shall be a cylinder with an internal structure designed to hold up to six SEFC's or sludge canisters in a vertical position during transportation in a cask.

Fuel/Sludge Transportation Cask (CNS 1-13G, or equivalent) The cask will be used to transport fuel and sludge samples held in the cask insert from the KE and KW Basins to the 327 Building. It shall be capable of being decontaminated before leaving the K Basin.

Gas/Liquid Sample Transport Systems The system will be used to transport gas/liquid samples to the 222S or 325 Building for isotope analysis. The PAS-1 cask may be used to transport these samples. However, a less robust shipping system may be used depending on sample dose rates. [This SDD does not cover the cask transportation process.]

Canister Sludge Sample Container This equipment is used to contain individual sludge samples taken from storage canisters. The containers shall be cylindrical and of sufficient volume to permit recovery of at least 500 ml of sludge. The lid shall be provided with a small valve connection to permit hydrogen testing (see Reference 6).

## 5.0 SYSTEM OPERATION

The KE Basin stores spent nuclear fuel in open canisters. The KW Basin stores fuel in canisters that are sealed by lids. The process will include sampling fuel and sludge from canisters in both basins, but not necessarily both fuel and sludge from the same canister. Figures 4 and 5 are process flow diagrams for KE Basin and KW Basin, respectively.

The sequence of operation for fuel and canister sampling depends on the design of the storage canister being sampled. The most complex procedure is associated with the MkI sealed canister which has a piston lid that requires internal pressurization to remove. Of lesser complexity is the MkII canister which has an external lid secured with a locking bar. The least complex are the open canisters in KE Basin which do not require gas and liquid sampling or need to be decapped. The basin sequence of operation is summarized in Table 4, and described below:

Sample Storage Canister Gas and Liquid Sampling of the gas and liquid content of capped storage canisters is needed to meet DQO requirements and as a screening technique for selecting canisters to be opened for fuel and/or sludge samples.

The MkI and MkII canisters are provided with two vent valves on the top of the lid; one is in the center of the lid, the other is at the outer circumference of the lid. The center valve has an extension protruding approximately 2 1/2 inches down into the canister. These valves were used to add corrosion inhibitor to the canister water and to establish an inert gas space above the canister water and fuel when the fuel was encapsulated. These valves provide a means to sample the gas and liquid in the canister.

Pressurize MkI Storage Canister The MkI canister lid is basically a piston that is inserted into and fits flush with the top of the canister cylinder. The lid is sealed with a ring of Grafoil that is compressed. The nuts used to compress the ring must be loosened before the lid can be moved from its position in the canister cylinder. However, even after loosening the nuts, the lid will not slide out without applying force. It is for this reason that the inside of the canister needs to be pressurized during decapping operations.

Pressurization will be done by first using the vent valves to vent gas from the canister, then injecting pressurized water into the canister through the center vent valve. Because of canister design pressure limitations, the injection pressure should be limited to 120 psig. The MkI canister has a vent line connecting the

top of the lid to the gas trap. This line should be crimped to effectively shut off the path for leakage of pressurized water into the basin.

Remove Storage Canister Lid The design of the MkI and MkII lids are different and require somewhat different procedures. After the MkI lid is pushed out of the canister cylinder by hydraulic pressure, the lid will be resting on top of the cylinder. It must be lifted and set aside (away from the work area around the canister.) The MkII lid rests on top of the cylinder and is secured by a locking bar. The lid must be unlocked by loosening the nut and releasing the latching bar. It is then lifted and moved away from the work area. Neither type lid will be reused. They will be placed in containers and disposed of later using routine K Basin housekeeping procedures and equipment.

Remove Fuel Sample from Storage Canister The fuel stored in the K Basin and the subject of characterization is N Reactor fuel consisting of two concentric fuel cylinders, i.e., an outer fuel element, and an inner fuel element. Two sized mandrels, one to fit inside, expand and lift outer elements, the other to do the same with inner elements, will be used to lift fuel samples out of the canisters and place them in single element canisters.

Recap Storage Canister New canister lids will be used when canisters are recapped. It is anticipated that much of the tooling to decap the canisters will be used during recapping operations. In the case of MkI canisters, the new lid with Grafoil ring will be inserted into the cylinder until the top of the lid is flush with the top of the cylinder. The three nuts will then be tightened to compress the Grafoil ring against the cylinder to seal the canister. In the case of the MkII canisters, the lid will be lowered into the basin, centered on top of the canister, and secured with the locking mechanism to seal the canister.

After the canisters are sealed, the vent valves will be used to add liquid corrosion inhibitor. Then the valves will be used to establish an initial two inch inert gas space in the top of the canister.

If necessary, a seal cleaner will be utilized to remove excess Grafoil from the MkI canister sealing area.

Load Single Element Fuel Containers and Test for H<sub>2</sub> Fuel elements and fuel parts removed from storage canisters will be loaded into single element fuel containers (SEFC's) in preparation for loading into a shipping cask. The SEFC will be monitored for gas generation while the SEFC is in the basin.

Load SEFC's into Transportation Cask The transportation cask will be lowered into the basin and prepared for transportation of the SEFC's. Use will be made of a cask insert to hold the SEFC's in upright and approximately equally spaced positions. Adequate steps will be taken to reduce contamination of the transportation cask (e.g., strippable paint).

Prepare Cask for Shipment to the 327 Building The cask will be lifted out of the main basin and the strippable paint removed. Any required protective overpack and shielding will then be installed. The cask will be installed and secured on a vehicle suitable for transporting heavy loads on Hanford Reservation roads.

Procedures and requirements for transportation of the cask to the 327 Building are described elsewhere (Reference 5).

## 6.0 SYSTEM LIMITATIONS, CASUALTY EVENTS, AND RESPONSE TO EVENTS

### 6.1 MINOR OFF-NORMAL EVENTS

The following events may occur during the course of fuel sampling and are considered to have minor consequences.

Basin Loss of Electric Power *Response:* This event could affect basin ventilation, basin hoists, and operation of electrically powered equipment associated with fuel sampling. If there is a loss of ventilation, further sampling steps will be stopped and personnel will respond in accordance with established K Basin procedures for this type of event.

Events Involving the Gas/Liquid Sampler There are several possible minor events involving this equipment:

- **Failed sampler** *Response:* Pull out of basin and repair.
- **Vent valve used for sampling fails to open** *Response:* Abandon attempts to obtain sample from the canister.
- **Vent valve fails to close after sampling** *Response:* Remaining gas in the canister may continue to vent into the basin. Notify the HPT.

MKI Crimping Tool Fails to Adequately Crimp *Response:* Attempt to pressurize the canister. If lid does not move out of canister cylinder, remove crimping tool from basin and repair or replace.

Note: An uncrimped tube may not significantly affect the capability of the pressurizing system to push the lid out of the canister cylinder.

Failure of Other Spent Fuel System Sampling System Equipment *Response:* Most of the equipment is designed to be operated from the grate level of the basin and can be taken up for repair. Plans for such repair will be made between Operations and SNFE staff to optimize the process and ALARA concerns.

Local Electrical Power Loss *Response:* Put equipment in "standby" mode (i.e., power switches off, power disconnected, etc.) and under direction of PIC and Test Engineer leave area until power is restored.

Radiation Monitoring Instrumentation Failure *Response:* Sampling should be stopped and not resumed until PIC and Test Engineer and HPT supervisor are satisfied that adequate monitoring can be performed.

Evacuation of Facility *Response:* Sampling or preparations for sampling must be stopped as soon as the evacuation alarm sounds and the area evacuated. Equipment should be left with power disconnected. Any off-normal condition of the equipment must be communicated by the PIC to the shift or facility managers or other responsible staff, so the condition is clear to staff restarting the activity after the evacuation.

Spills and Leakage of Gas/Liquid Sample *Response:* Any spills or leaks will be evaluated by PIC and HPT and handled consistent with normal Basin practices (as appropriate, the shift and facility managers will be involved in the evaluation).

## 6.2 SIGNIFICANT OFF-NORMAL EVENTS

Overdilution of Gas/Liquid Sample *Response:* The sampler will be periodically tested using a reference source. If duration is significant, the sampler will be repaired and samples repeated, if possible.

## 7.0 REFERENCES

1. Letter, G.E. Culley (WHC) to C.A. Hansen (RL), "K Basin Sludge Disposition Strategy," WHC-9552284, April 24, 1995.
2. Administrative Procedure 7-003-00, **K Basin Project Review Process**, January 9, 1996.
3. Letter, D.W. Siddoway (WHC) to C.A. Hansen (RL), "K Basin Path Forward Action Items," WHC 9551459, March 15, 1995.
4. Memorandum of Agreement on Path Forward for K Basin SNF, dated February 14, 1995.
5. WHC-SD-TP-SEP-028, **N Reactor and Single Pass Reactor Fuel Characterization Shipments Safety Evaluation for Packaging**.
6. WHC-SD-SNF-SDD-004, **System Design Description for Sampling Sludge in K Basins Fuel Storage Canisters**, January 1996.

**Table 1**  
**Documents Supporting Design and Application of**  
**K Basin Fuel Sampling System**

| Name of Document   | Author         | Accepting Organizations |
|--|----------------|-------------------------|
| 1. Cold Feature Test Plan  | SNFE           |                         |
| 2. Cold Acceptance Test Plan   | SNFE           |                         |
| 3. Drawings  | SNFE           |                         |
| 4. Preliminary Design Review Report  | SNFE           | KR-0, KR-1              |
| 5. Final Design Review Report  | SNFE           | KR-2, KR-3              |
| 6. Final Design Package for Equipment  | SNFE           | KR-3                    |
| 7. Training Plan   | K Basin/SNFE   |                         |
| 8. K Basin Operating Procedures  | K Basin/SNFE   |                         |
| 9. Master Work Plan  | K Basin/SNFE   |                         |
| 10. Data Quality Objectives  | SNFE           |                         |
| 11. Sample Analysis Plan   | SNFE           |                         |
| 12. System Design Description<br>SNFP Need<br>Function and Requirements<br>General Work Plan<br>Process Flow<br>Design Description | SNFE           | KR-0, KR-1, KR-2        |
| 13. QA Plan  | QA/SNFE        |                         |
| 14. Waste Management Plan  | K Basin        |                         |
| 15. ALARA Assessment   | K Basin + SNFE |                         |
| 16. USQ/Hazard Categorization  | K Basin        |                         |
| 17. Readiness Assessment Checklist   | K Basin/SNFE   |                         |
| 18. Job Hazards Analysis   | K Basin/SNFE   |                         |
| 19. Cask SEP Mod (as needed)   | Pak/SNFE       |                         |
| 20. Report Results First Run   | SNFE           |                         |

SNFE: Characterization Group Spent Nuclear Fuel Evaluations  
 KR-0, KR-1, KR-2, KR-3: K Basin Review Bodies  
 POC: K Basin Point of Contact  
 RL: Richland Operation DOE  
 ES: Engineering Support Group  
 K Basin: K Basin Operations Staff  
 Pak: Packaging and Transport Group  
 QA: Quality Assurance Group

**Table 2**  
**List of Primary Responsibilities**

|   | Organization                             | Staff-Lead/Support                   |
|---|--|--------------------------------------|
| Cognizant Manager for Characterization                                      | SNFE*                                    | R.P. Omberg                          |
| Characterization Program Interface, Integration, and Data Requirements      | SNFE/ES                                  | D.W. Bergmann                        |
| Data Quality Objectives   | SNFE                                     | B.J. Frankenbach/<br>Lecia Lawrence  |
| Sampling Analysis Plan  | SNFE                                     | R.B. Baker/T.L. Welsh                |
| Design Engineering of Equipment   | SNFE                                     | A.E. Bridges<br>P.J. MacFarlan       |
| Design and Application Interface between K Basin and Characterization Group | SNFE (Characterization)<br>K Basin (POC) | D.W. Bergmann<br>C.D. Kirk           |
| Work Plan and Procedures  | K Basin/SNFE                             | J.J. Hornberg                        |
| K Basin Safety Standards and Requirements of the K Basin Organization       | K Basin                                  | R. Gant                              |
| K Basin Safety of the SNFP Organization                                     | K Basin                                  | D. Hess                              |
| Transportation of Samples   | SNFE/Pak* /K Basin                       | S.A. Chastain<br>S. Crow<br>C. Lucas |
| Training  | K Basin                                  | L. Biehm                             |
| Quality Assurance   | SNFQA                                    | D.W. Smith                           |
| Air Permit  | K Basin                                  | R. Gant                              |

\*SNFE                   Spent Nuclear Fuel Evaluations Group  
 ES                       Engineering Support Group  
 Pak                      Packaging and Transport Group

**Table 3**  
**Equipment and Functions**

| Equipment   | KW Basin<br>MkI Canister | KW Basin<br>MkII Canister | KE Basin<br>Open Canister |
|---|--------------------------|---------------------------|---------------------------|
| Gas/Liquid Sampler                                  | x                        | x                         |                           |
| Valve Stem Handling Tool                            | x                        |                           |                           |
| Tube Crimping Tool                                  | x                        |                           |                           |
| Nut Handling Tool                                   | x                        |                           |                           |
| Pressure System                                     | x                        |                           |                           |
| Lid Handling Tool                                   | x                        | x                         |                           |
| Fuel Removal Tool                                   | x (NOTE 1)               | x (NOTE 1)                | x (NOTE 1)                |
| Purge Tool  | x (NOTE 2)               | x (NOTE 2)                |                           |
| Fuel Canister Manual Valve Operator                 |                          |                           |                           |
| Single Element Canister                             | x                        | x                         | x                         |
| H2 Tester   | x                        | x                         | x                         |
| Cask Insert   | x                        | x                         | x                         |
| Fuel Sludge Sample Cask                             | x                        | x                         | x                         |
| Gas/Liquid Sample Cask                              | x                        | x                         |                           |
| Canister Sludge Sample Containers<br>(Reference 6)  | x                        | x                         | x                         |
| Canister Sludge Sampling Equipment<br>(Reference 6) | x                        | x                         | x                         |

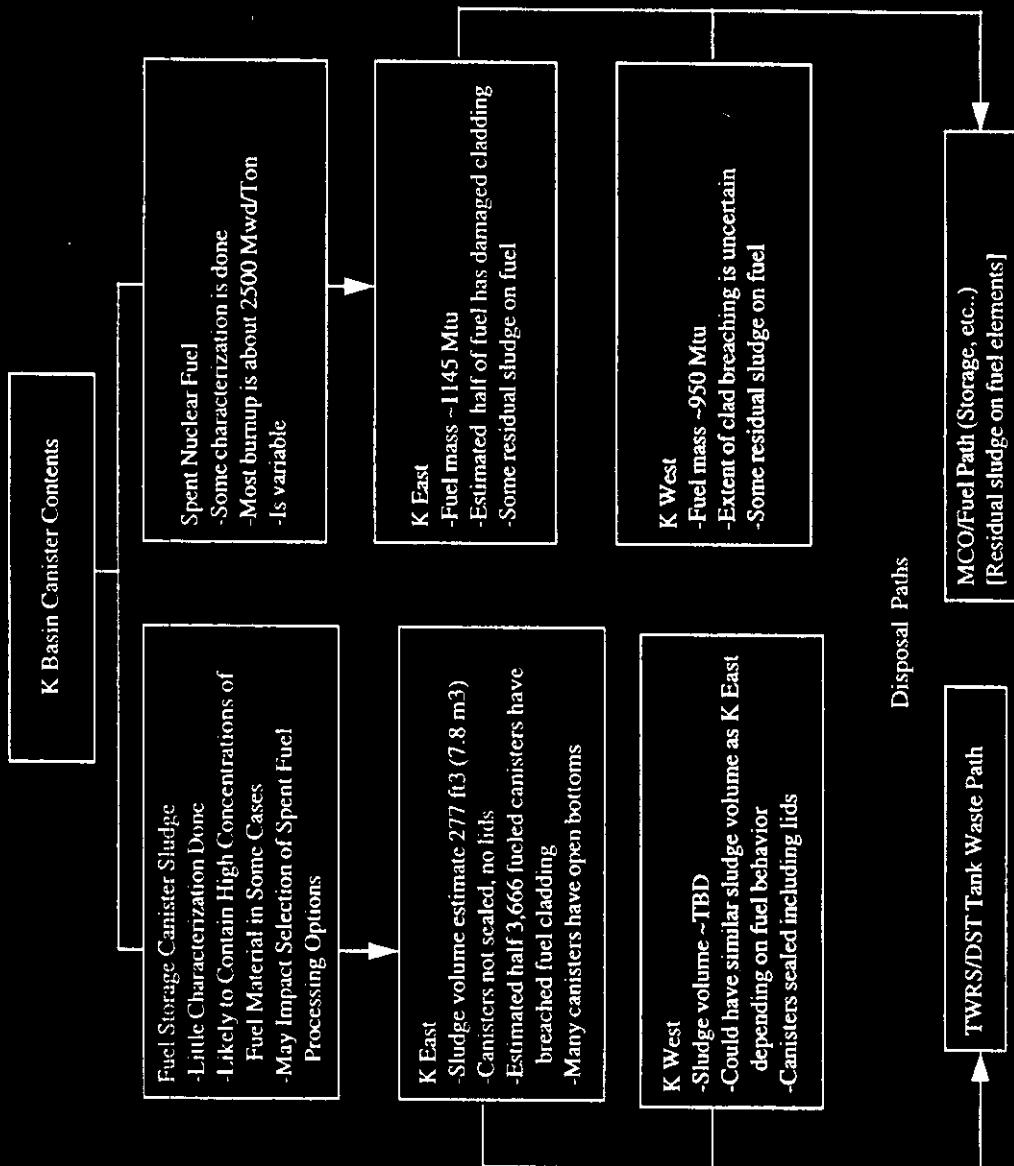
## NOTES:

- (1) Different for each type of fuel
  - Outer fuel element - use existing large diameter mandrel
  - Inner - longer small diameter under development
- (2) Different for each indicated canister type
  - MkII - use existing tool
  - MkI - modify existing tool

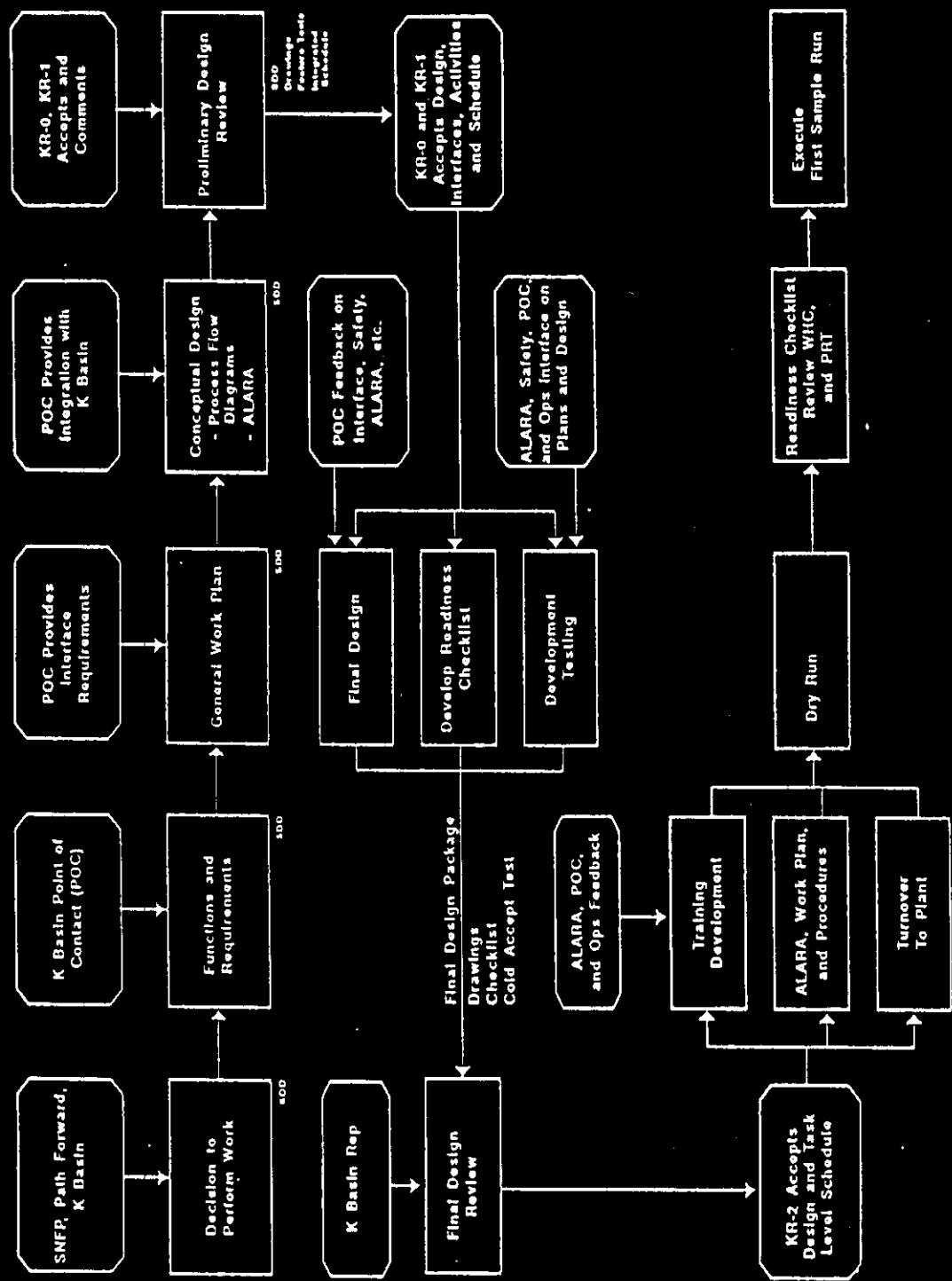
**Table 4**  
**Sequence of Operation**

| Operation  | Basin |      |            |
|--|-------|------|------------|
|  | KW    | MkII | KE<br>Open |
| Move Canister to Sampling Location                                 | x     | x    |            |
| Sample Storage Canister Gas and Liquid                             | x     | x    |            |
| Pressurize Storage Canister  | x     |      |            |
| Remove Storage Canister Lid  | x     | x    |            |
| Remove Fuel and/or Sludge Sample from Storage Canister             | x     | x    | x          |
| Recap Storage Canister   | x     | x    |            |
| Move Canister Back to Storage Location                             | x     | x    |            |
| Load Single Element Fuel Canister and Test for H2                  | x     | x    | x          |
| Load Sludge into Sample Container and Test for H2<br>(Reference 6) | x     | x    | x          |
| Load SEFC into Transportation Cask                                 | x     | x    | x          |
| Prepare Cast for Shipment to 327 Building                          | x     | x    | x          |

**Figure 1**  
**Overview of K Basin SNF Canister Contents and Path Forward**



**Figure 2**  
**Proposed K Basin Plant Review of Fuel Sampling System**  
**Development and Application**



**Figure 3**  
**Work Breakdown for Development and Application of**  
**K Basin Fuel Sampling System**

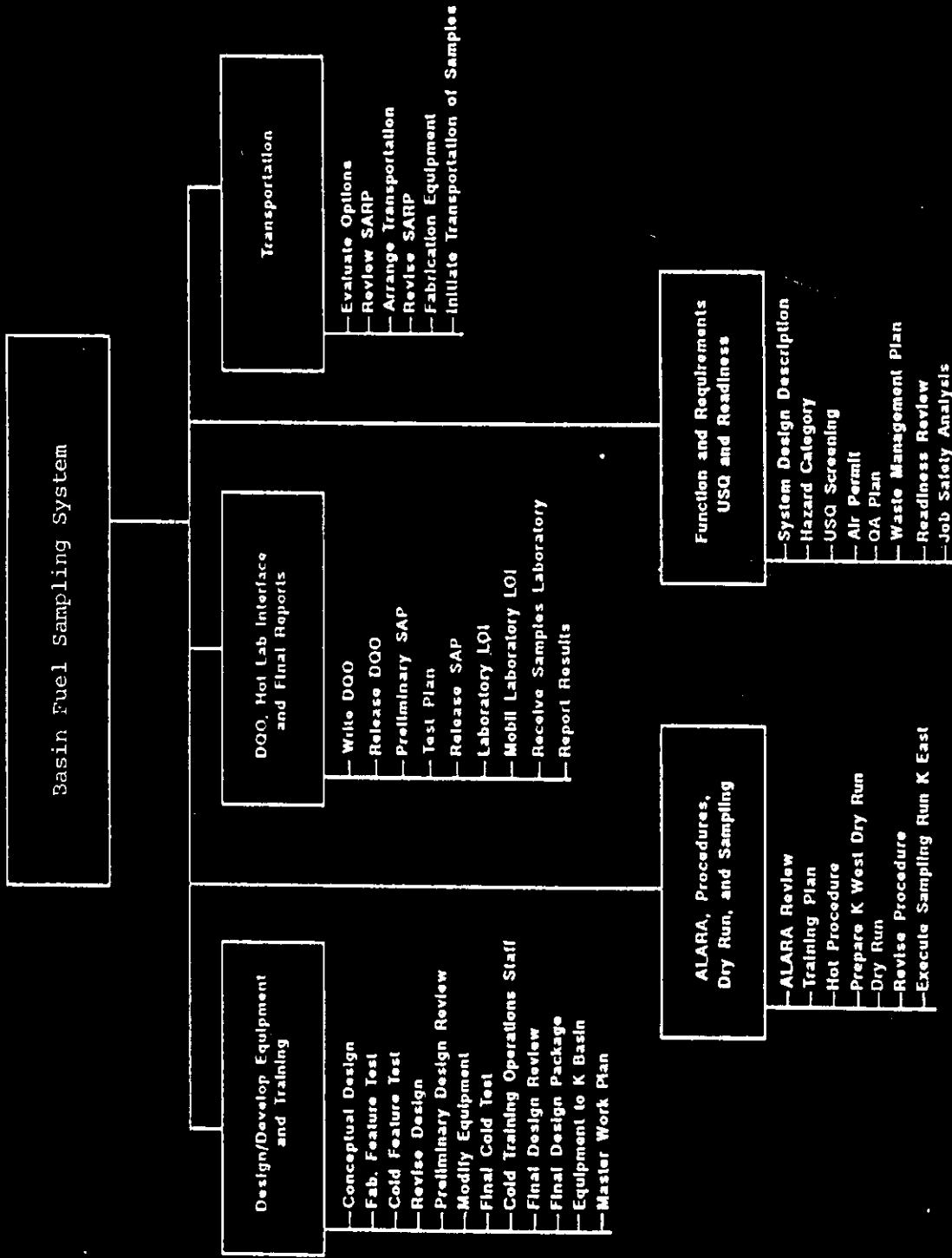
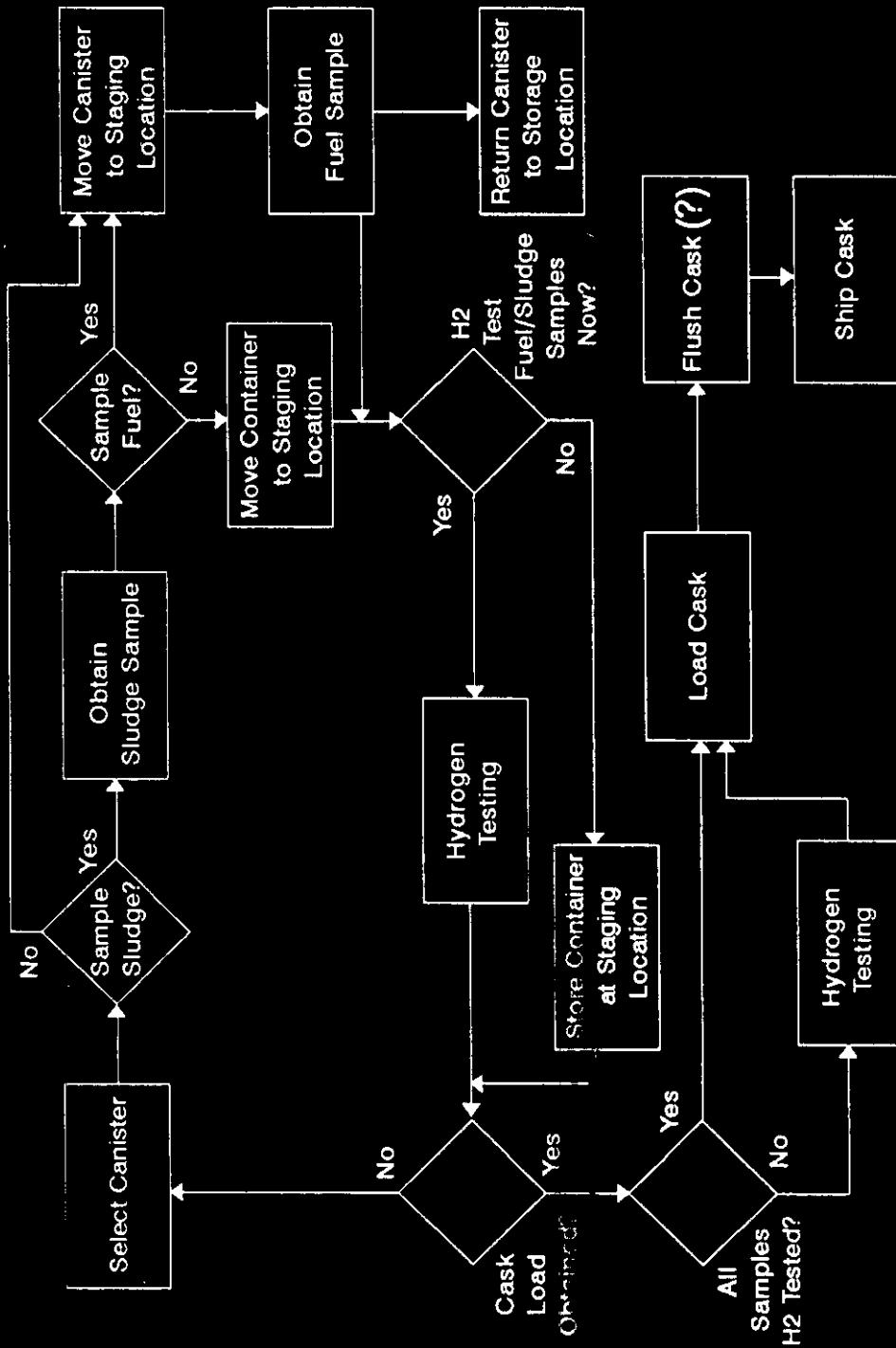
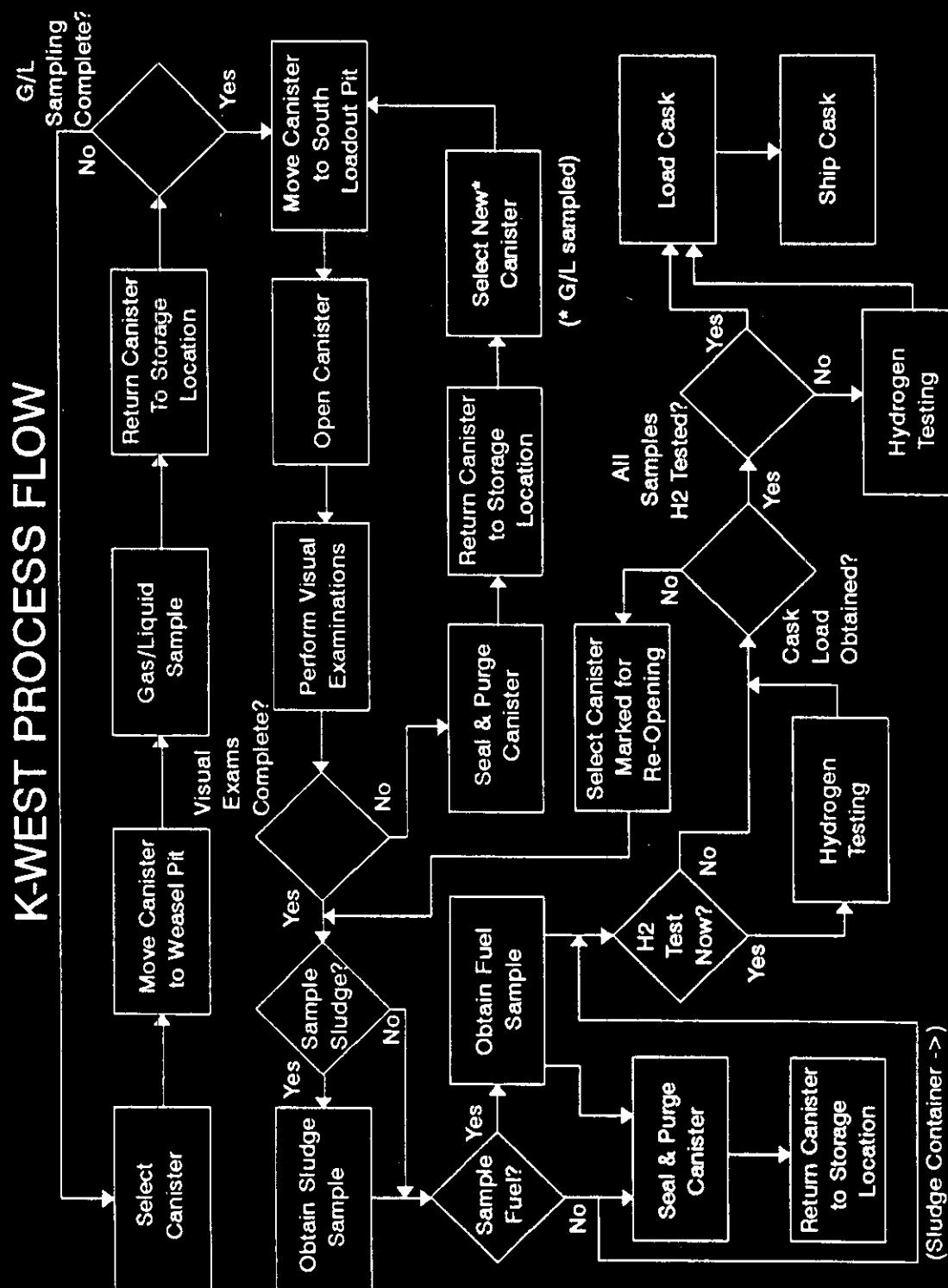


Figure 4  
K-East Process Flow

## K-EAST PROCESS FLOW



**Figure 5**  
K-West Process Flow



**APPENDIX A**  
**EQUIPMENT DESIGN DRAWINGS**  
**(DRAFT)**

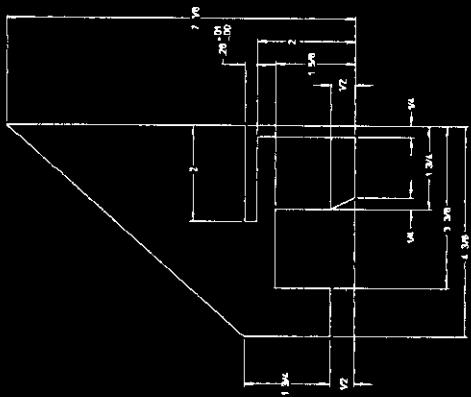
FOR GENERAL NOTES AND PARTS LIST SEE SH-1



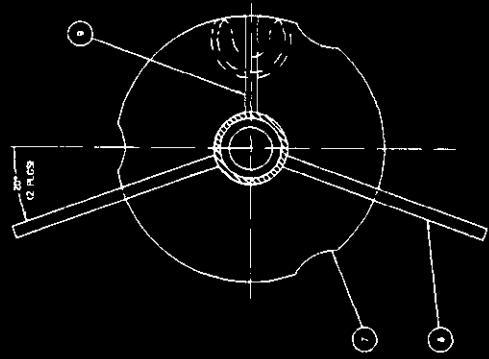
7



ASSEMBLY. HANDLE BODY



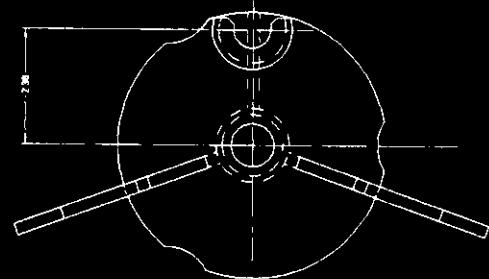
SECTION C-C



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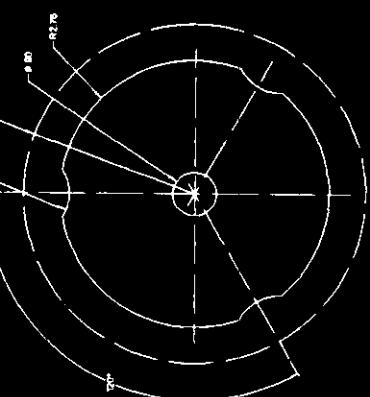
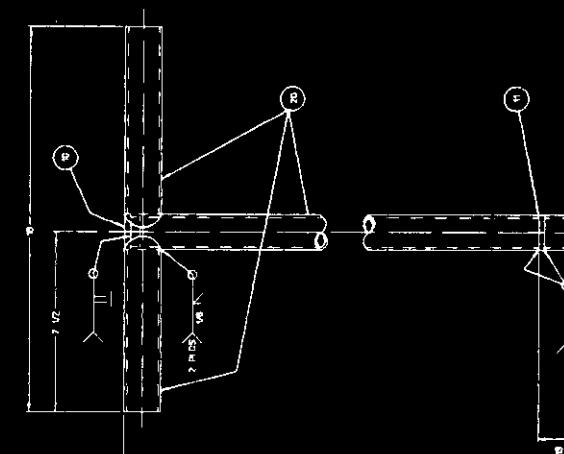
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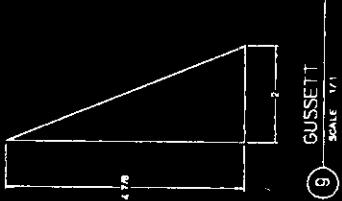


CLAMP SLEEVE  
12 SCALE 1:1

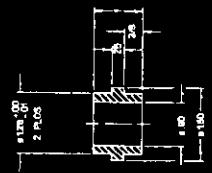
GUIDE. TOP  
SCALE 1/4



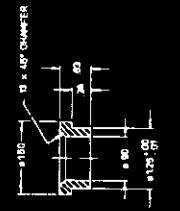
CLAMP BASE  
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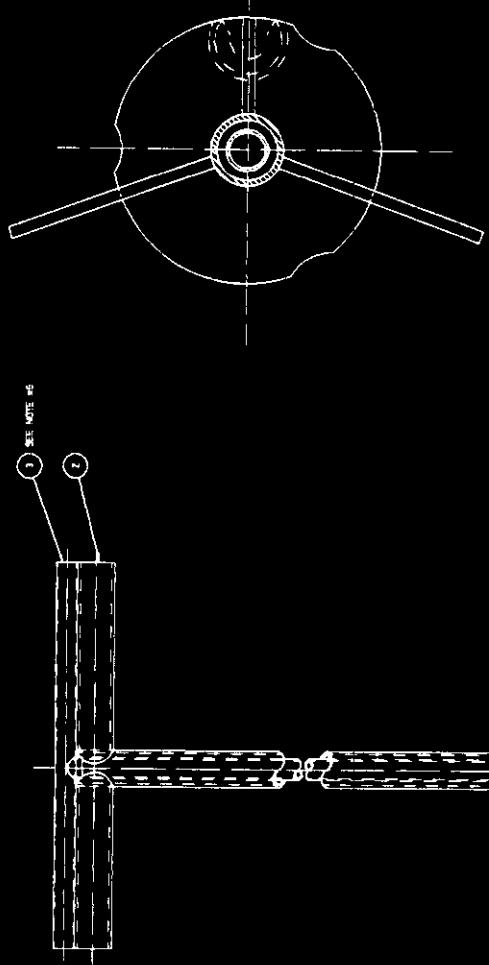


GUIDE, CENTER  
SCALE 1:1  
11



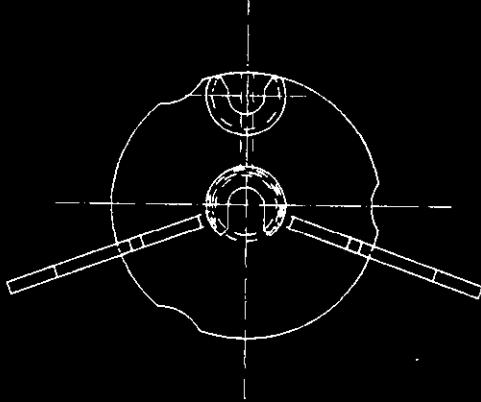
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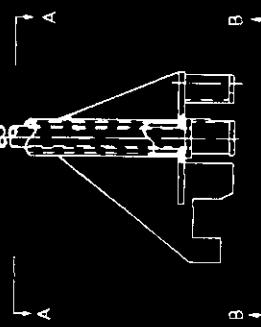
SECTION A-A

SCALE 1/2



VIEW B-B

SCALE 1/2



ASSEMBLY LID REPLACEMENT TOOL

SCALE 1/2

# FOR INFORMATION ONLY

## GENERAL NOTES: UNLESS OTHERWISE SPECIFIED

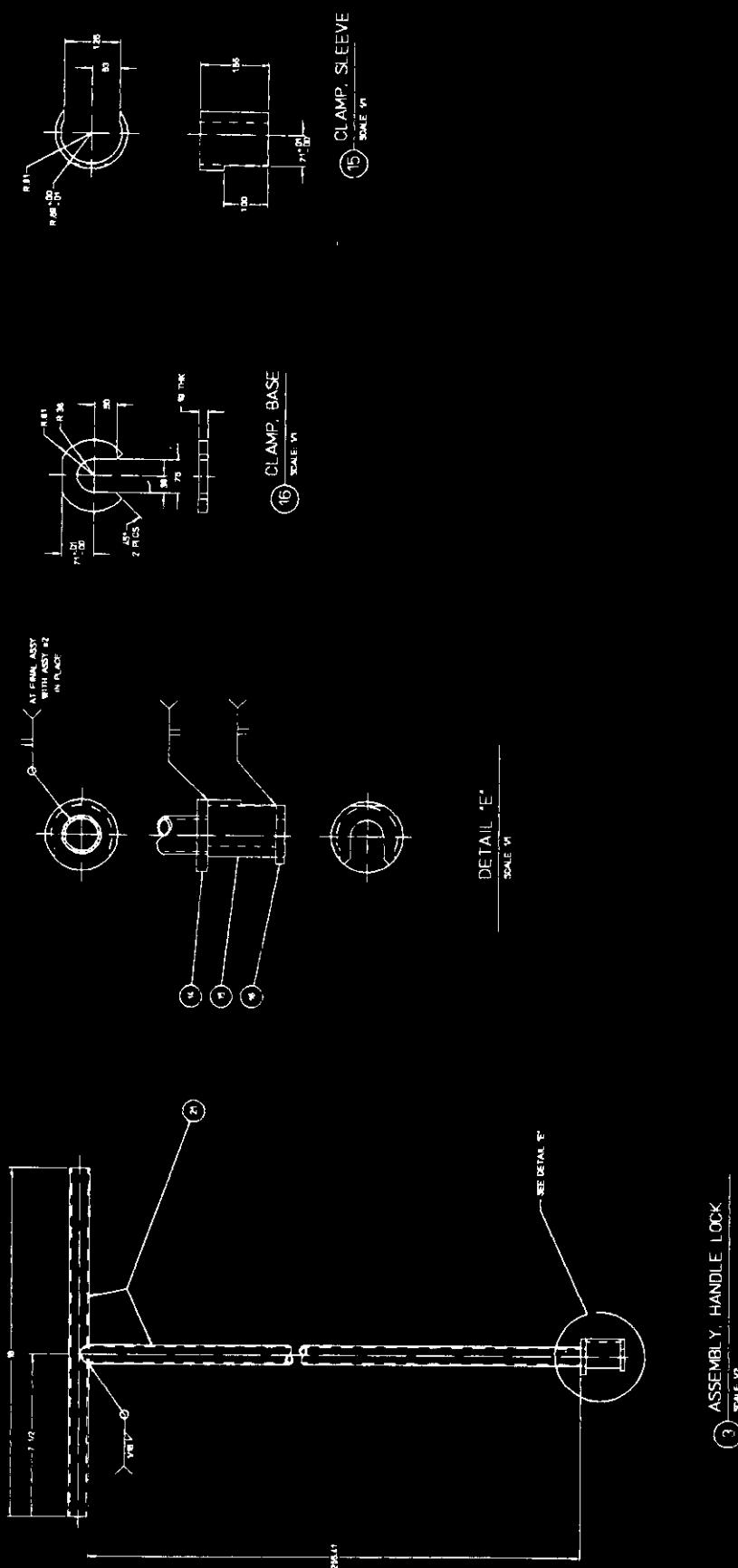
1. DIMENSIONS ARE IN INCHES. DIMENSION TOLERANCES: DECIMAL .001, DEC 1.000, FRACTIONAL .001, INCHES .001, ANGULAR .1°
2. BREAK ALL SHARP CORNERS. REMOVE ALL BURRS.
3. ALL MACHINED SURFACES ON THE THER IN ACCORDANCE WITH ANSI B8.4-1973.
4. MACHINED FLAT (WALL) SHALL BE .020 MAX.
5. WHEN END OF BOTH HANDLES ARE ARMED TOOL IS IN LOADED POSITION.

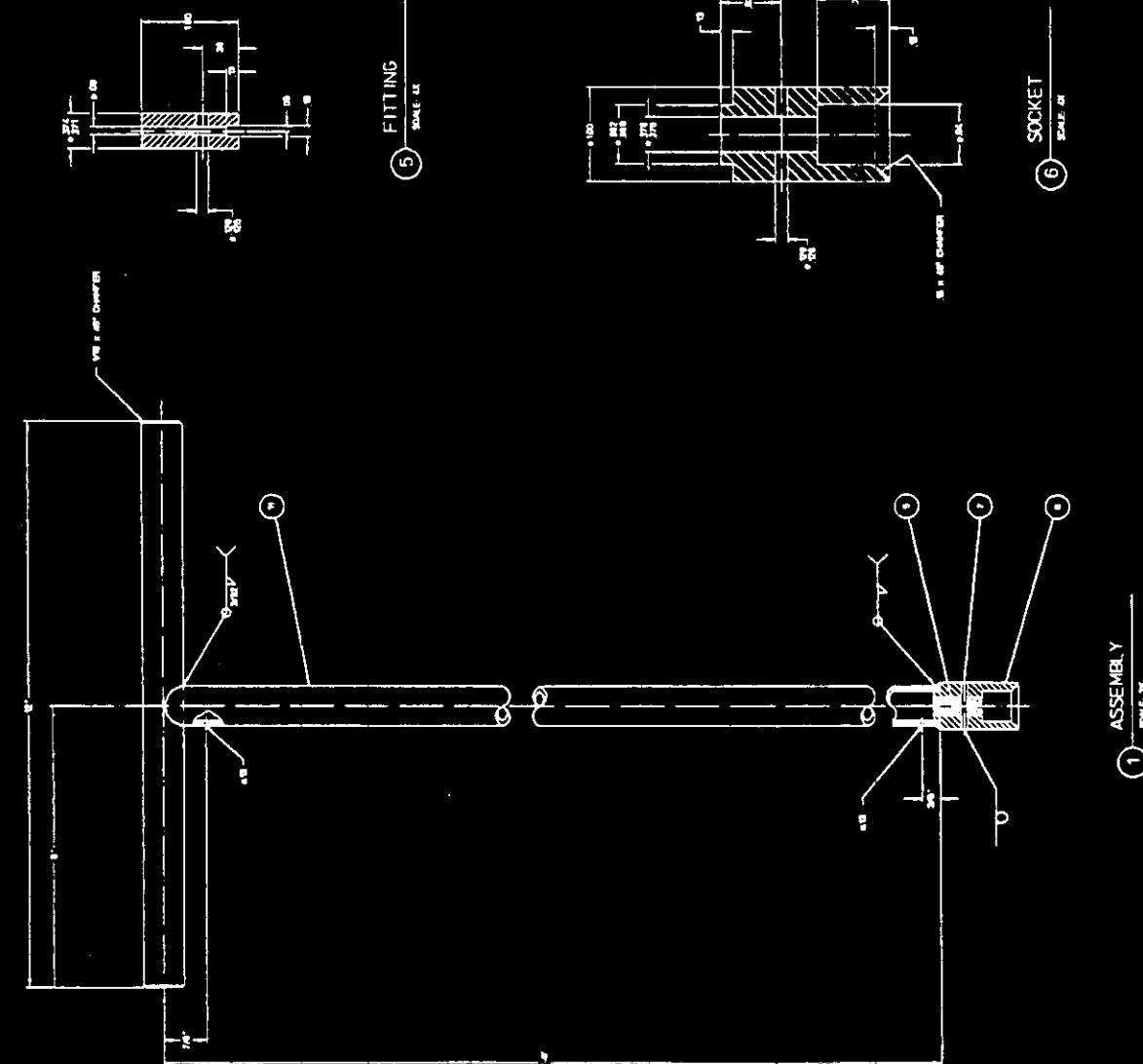
| S. 1000 |     | S. 1000 |     | S. 1000 |     |
|---------|-----|---------|-----|---------|-----|
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| 13      | 14  | 15      | 16  | 17      | 18  |
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| 631     | 632 | 633     | 634 | 635     | 636 |
| 637     | 638 | 639     | 640 | 641     | 642 |
| 643     | 644 | 645     | 646 | 647     | 648 |
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| 661     | 662 | 663     | 664 | 665     | 666 |
| 667     | 668 | 669     | 670 | 671     | 672 |
| 673     | 674 | 675     | 676 | 677     | 678 |
| 679     | 680 | 681     | 682 | 683     | 684 |
| 685     | 686 | 687     | 688 | 689     | 690 |
| 691     | 692 | 693     | 694 | 695     | 696 |
| 697     | 698 | 699     | 700 | 701     | 702 |
| 703     | 704 | 705     | 706 | 707     | 708 |
| 709     | 710 | 711     | 712 | 713     | 714 |
| 715     | 716 | 717     | 718 | 719     | 720 |
| 721     | 722 | 723     | 724 | 725     | 726 |
| 727     | 728 | 729     | 730 | 731     | 732 |
| 733     | 734 | 735     | 736 | 737     | 738 |
| 739     | 740 | 741     | 742 | 743     | 744 |
| 745     | 746 | 747     | 748 | 749     | 750 |
| 751     | 752 | 753     | 754 | 755     | 756 |
| 757     | 758 | 759     | 760 | 761     | 762 |
| 763     | 764 | 765     | 766 | 767     | 768 |
| 769     | 770 | 771     | 772 | 773     | 774 |
| 775     | 776 | 777     | 778 | 779     | 780 |
| 781     | 782 | 783     | 784 | 785     | 786 |
| 787     | 788 | 789     | 790 | 791     | 792 |
| 793     | 794 | 795     | 796 | 797     | 798 |
| 799     | 800 | 801     | 802 | 803     | 804 |
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| 937     | 938 | 939     | 940 | 941     | 942 |
| 943     | 944 | 945     | 946 | 947     | 948 |
| 949     | 950 | 951     | 952 | 953     | 954 |
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| 979     | 980 | 981     | 982 | 983     | 984 |
| 985     | 986 | 987     | 988 | 989     | 990 |
| 991     | 992 | 993     | 994 | 995     | 996 |
| 997     | 998 | 999     | 999 | 999     | 999 |

END GENERAL NOTES AND PARTS LIST PAGE 11



8





GENERAL NOTES unless otherwise specified

DIMENSIONS ARE IN INCHES.

1. TOLUOLNEON TUBE, 1/8 IN. DIA. X 40 IN. LENGTH, 250 VOLTS, 100 AMPS, 1000°F. MAX. TEMP. OF APPARATUS.
2. ALL MODIFIED SURFACES ON BOTTOM IN ACCORDANCE WITH MAX. MAX. PLATELET RESISTANCE.
3. IRON SHEET 1/8 IN. THICK, 100 VOLTS, 100 AMPS.
4. IRON SHEET 1/8 IN. THICK, 100 VOLTS, 100 AMPS.
5. ALL MODIFIED IRON, 1/8 IN. MAX.

# FOR INFORMATION ONLY

## GENERAL NOTES

2. TELEPHONE: FUNCTIONAL - 1000  
DEG. 50' X 1000' - 4000' - 4000'  
AMPLIFIED AT  
EASTERN KEYBOARD.

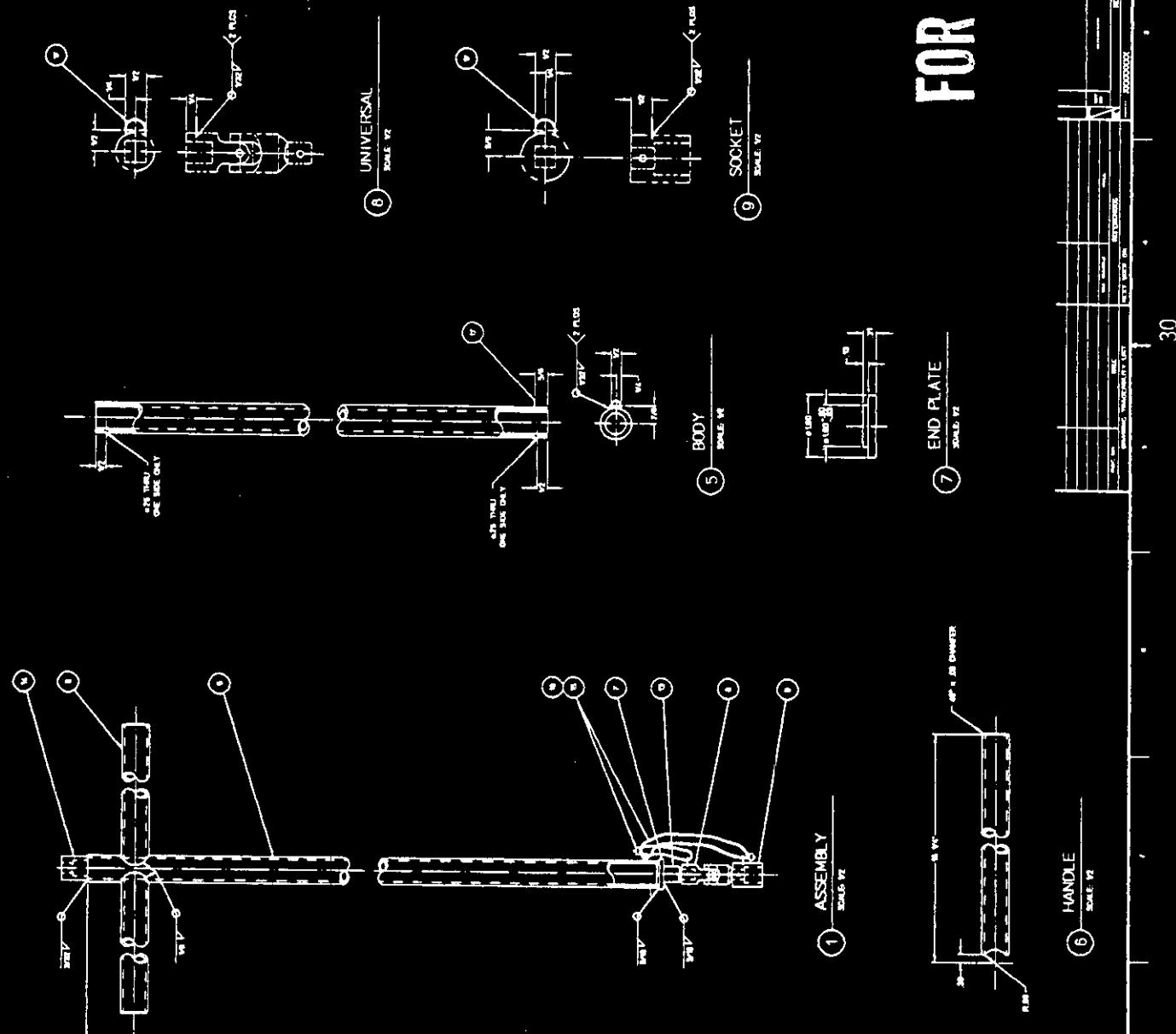
3. ALL MOVED IN OFFICES BY  
EASTERN KEYBOARD.

4. BREAK ALL PAPER STICKERS AND REMOVE ALL STICKERS.

5. ALL WIRENODDED MEDIUM SHELLS ARE 30 VOLTS.

6. BATTERY CHARGERS ARE TO BE MOVED TO 77-30 VOLTS.  
SOUTHERN, EAST & WEST DIVISIONS.  
UNIVERSITY, 92 DIVISION.

FOR INFORMATION ONLY



## GENERAL NOTES

1 DIMENSIONS AND TOLERANCES PER ASME Y14.52  
DIMENSIONS ARE IN INCHES

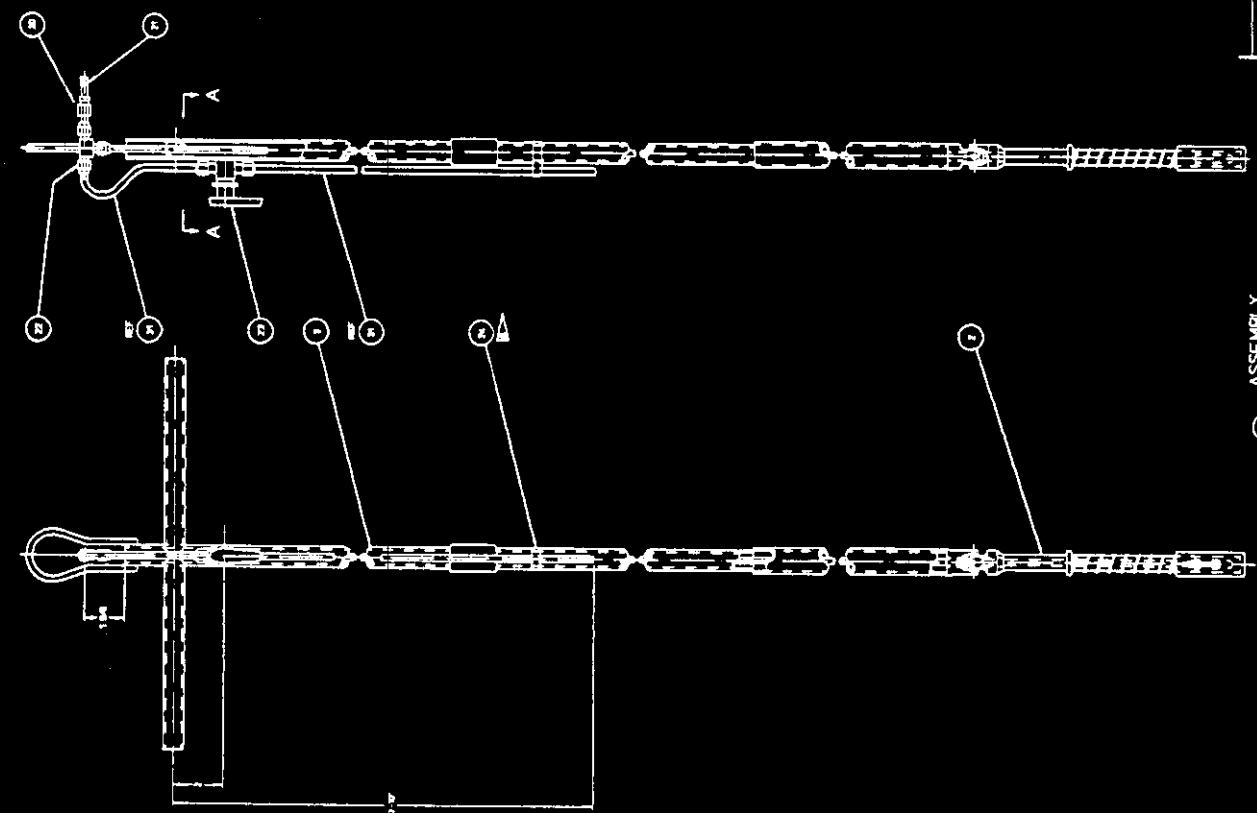
2 TOLERANCES: FRACTIONAL - 0.005  
DECIMAL, IN. - 0.005 - 0.008  
ANGULAR - 0.005

3 ALL INCHED SURFACES OR LETTER IN ACCORDANCE  
WITH ASME B8.1 LATEST PUBLICATION

4 SPEC ALL SURFACES AND REMOVE ALL BURRS

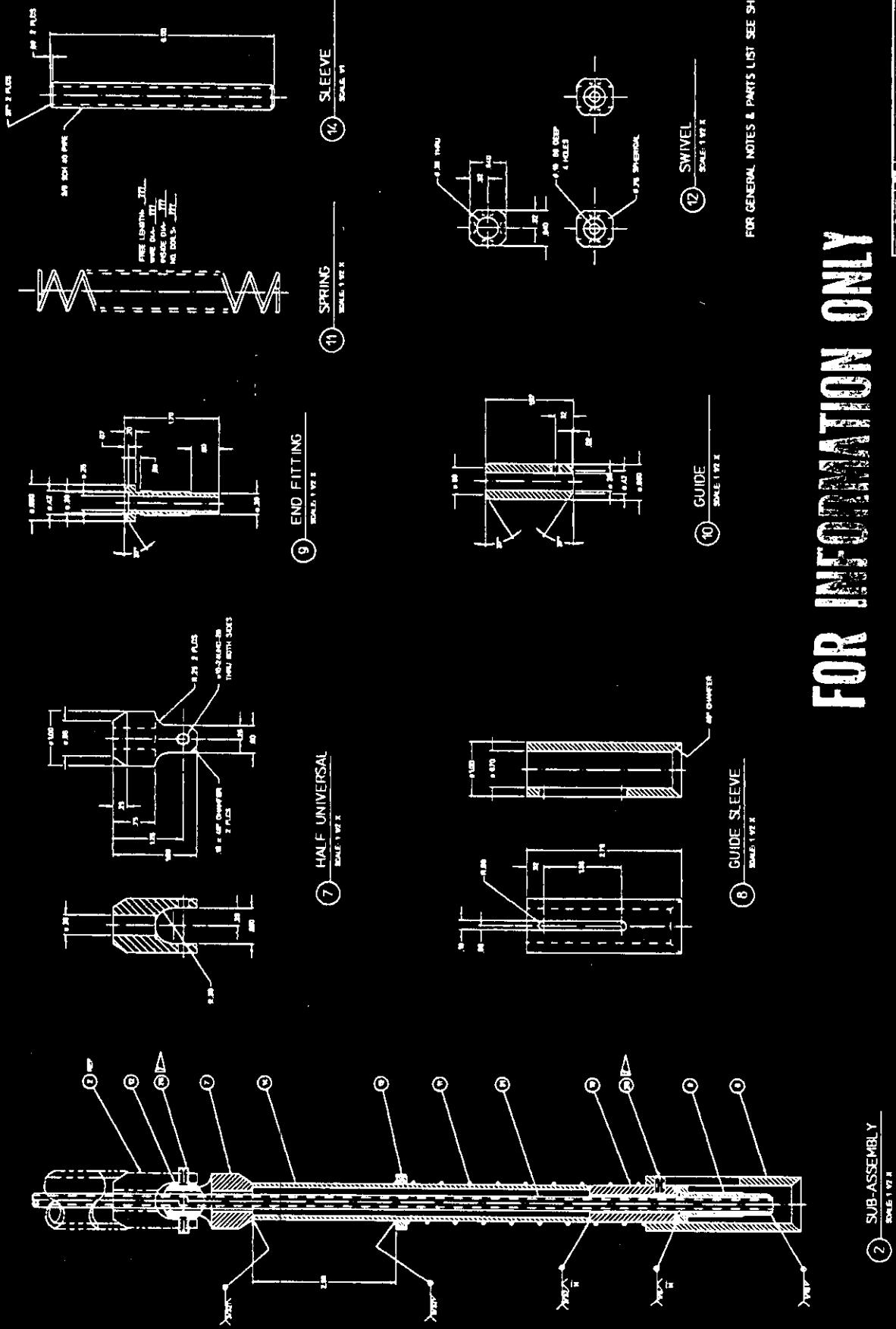
5 ALL INCHED MORT. BULL. BE OR MARK

6 LOCATE ITEM #2 & APPROX. 30° SPEC IN STARTING  
FROM ITEM #4  
 LOCATE ITEM #1



SECTION A-A

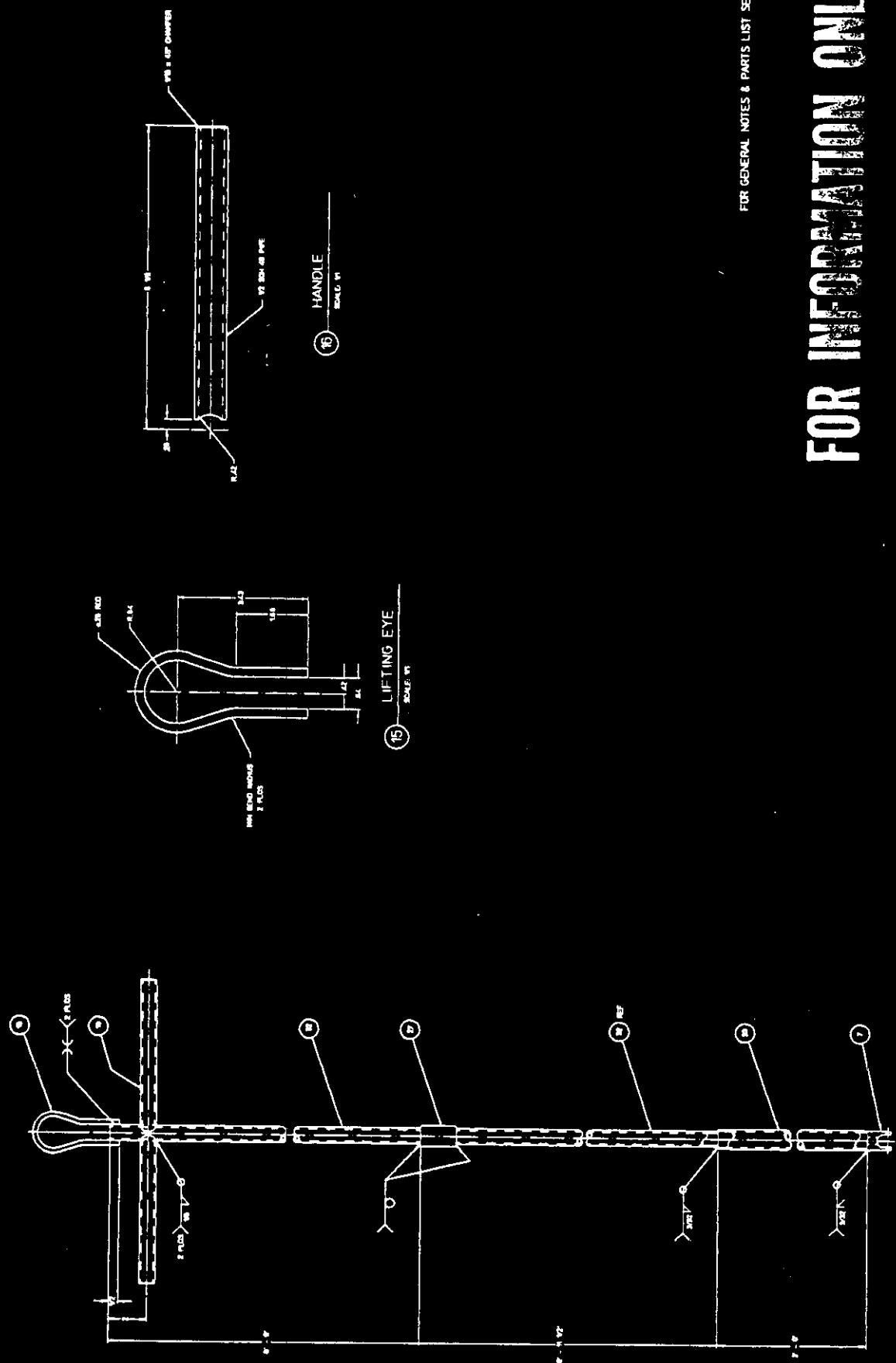
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FOR INFORMATION ONLY

FOR GENERAL NOTES & PARTS LIST SEE SH-1

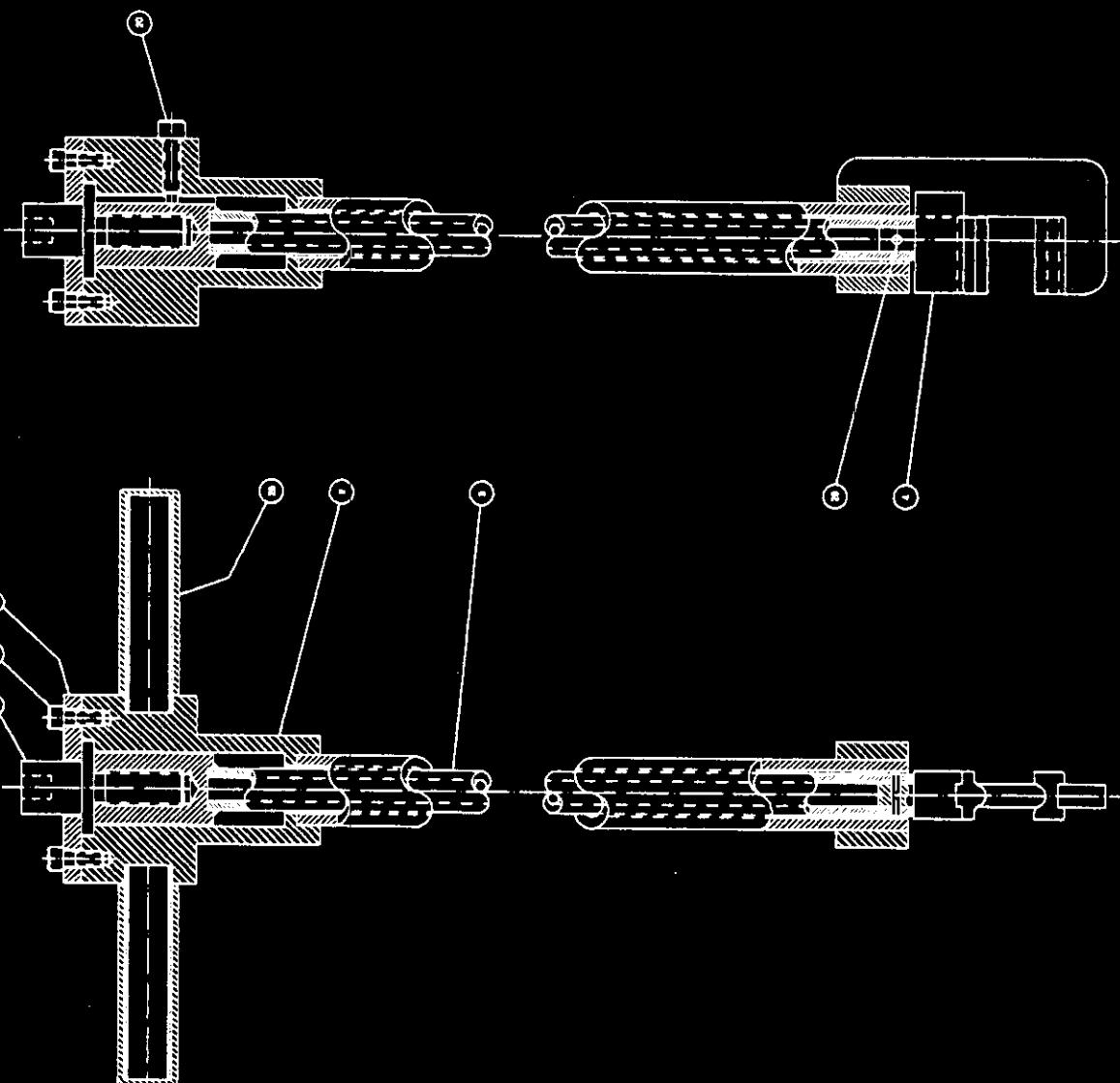
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| 617                       | 618 | 619                       | 620  |
| 621                       | 622 | 623                       | 624  |
| 625                       | 626 | 627                       | 628  |
| 629                       | 630 | 631                       | 632  |
| 633                       | 634 | 635                       | 636  |
| 637                       | 638 | 639                       | 640  |
| 641                       | 642 | 643                       | 644  |
| 645                       | 646 | 647                       | 648  |
| 649                       | 650 | 651                       | 652  |
| 653                       | 654 | 655                       | 656  |
| 657                       | 658 | 659                       | 660  |
| 661                       | 662 | 663                       | 664  |
| 665                       | 666 | 667                       | 668  |
| 669                       | 670 | 671                       | 672  |
| 673                       | 674 | 675                       | 676  |
| 677                       | 678 | 679                       | 680  |
| 681                       | 682 | 683                       | 684  |
| 685                       | 686 | 687                       | 688  |
| 689                       | 690 | 691                       | 692  |
| 693                       | 694 | 695                       | 696  |
| 697                       | 698 | 699                       | 700  |
| 701                       | 702 | 703                       | 704  |
| 705                       | 706 | 707                       | 708  |
| 709                       | 710 | 711                       | 712  |
| 713                       | 714 | 715                       | 716  |
| 717                       | 718 | 719                       | 720  |
| 721                       | 722 | 723                       | 724  |
| 725                       | 726 | 727                       | 728  |
| 729                       | 730 | 731                       | 732  |
| 733                       | 734 | 735                       | 736  |
| 737                       | 738 | 739                       | 740  |
| 741                       | 742 | 743                       | 744  |
| 745                       | 746 | 747                       | 748  |
| 749                       | 750 | 751                       | 752  |
| 753                       | 754 | 755                       | 756  |
| 757                       | 758 | 759                       | 760  |
| 761                       | 762 | 763                       | 764  |
| 765                       | 766 | 767                       | 768  |
| 769                       | 770 | 771                       | 772  |
| 773                       | 774 | 775                       | 776  |
| 777                       | 778 | 779                       | 780  |
| 781                       | 782 | 783                       | 784  |
| 785                       | 786 | 787                       | 788  |
| 789                       | 790 | 791                       | 792  |
| 793                       | 794 | 795                       | 796  |
| 797                       | 798 | 799                       | 800  |
| 801                       | 802 | 803                       | 804  |
| 805                       | 806 | 807                       | 808  |
| 809                       | 810 | 811                       | 812  |
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| 817                       | 818 | 819                       | 820  |
| 821                       | 822 | 823                       | 824  |
| 825                       | 826 | 827                       | 828  |
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| 833                       | 834 | 835                       | 836  |
| 837                       | 838 | 839                       | 840  |
| 841                       | 842 | 843                       | 844  |
| 845                       | 846 | 847                       | 848  |
| 849                       | 850 | 851                       | 852  |
| 853                       | 854 | 855                       | 856  |
| 857                       | 858 | 859                       | 860  |
| 861                       | 862 | 863                       | 864  |
| 865                       | 866 | 867                       | 868  |
| 869                       | 870 | 871                       | 872  |
| 873                       | 874 | 875                       | 876  |
| 877                       | 878 | 879                       | 880  |
| 881                       | 882 | 883                       | 884  |
| 885                       | 886 | 887                       | 888  |
| 889                       | 890 | 891                       | 892  |
| 893                       | 894 | 895                       | 896  |
| 897                       | 898 | 899                       | 900  |
| 901                       | 902 | 903                       | 904  |
| 905                       | 906 | 907                       | 908  |
| 909                       | 910 | 911                       | 912  |
| 913                       | 914 | 915                       | 916  |
| 917                       | 918 | 919                       | 920  |
| 921                       | 922 | 923                       | 924  |
| 925                       | 926 | 927                       | 928  |
| 929                       | 930 | 931                       | 932  |
| 933                       | 934 | 935                       | 936  |
| 937                       | 938 | 939                       | 940  |
| 941                       | 942 | 943                       | 944  |
| 945                       | 946 | 947                       | 948  |
| 949                       | 950 | 951                       | 952  |
| 953                       | 954 | 955                       | 956  |
| 957                       | 958 | 959                       | 960  |
| 961                       | 962 | 963                       | 964  |
| 965                       | 966 | 967                       | 968  |
| 969                       | 970 | 971                       | 972  |
| 973                       | 974 | 975                       | 976  |
| 977                       | 978 | 979                       | 980  |
| 981                       | 982 | 983                       | 984  |
| 985                       | 986 | 987                       | 988  |
| 989                       | 990 | 991                       | 992  |
| 993                       | 994 | 995                       | 996  |
| 997                       | 998 | 999                       | 1000 |



FOR GENERAL NOTES & PARTS LIST SEE SHEET 1

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## GENERAL NOTES NAMES OF ENTITIES REPORTED

DECIMAL - 1.00  
ANGULAR - 0° 00'

✓ 2. ALL MACHINED SURFACES  IN BETTER IN ACCORDANCE  
WITH ASME BA 10.0 TEST NEED.

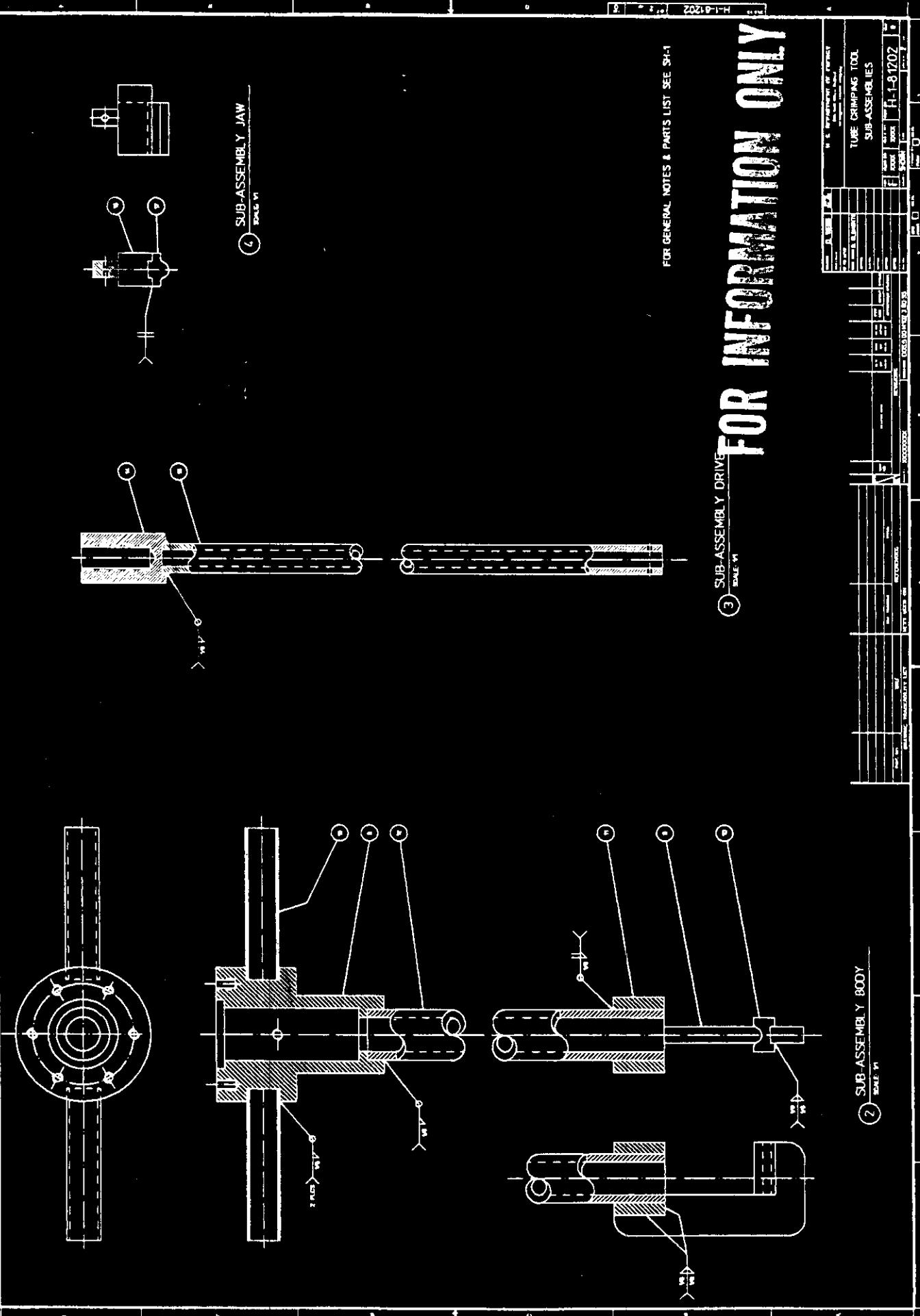
✓ 3. BREAK ALL SHARP EDGES, REMOVE ALL BURRS.

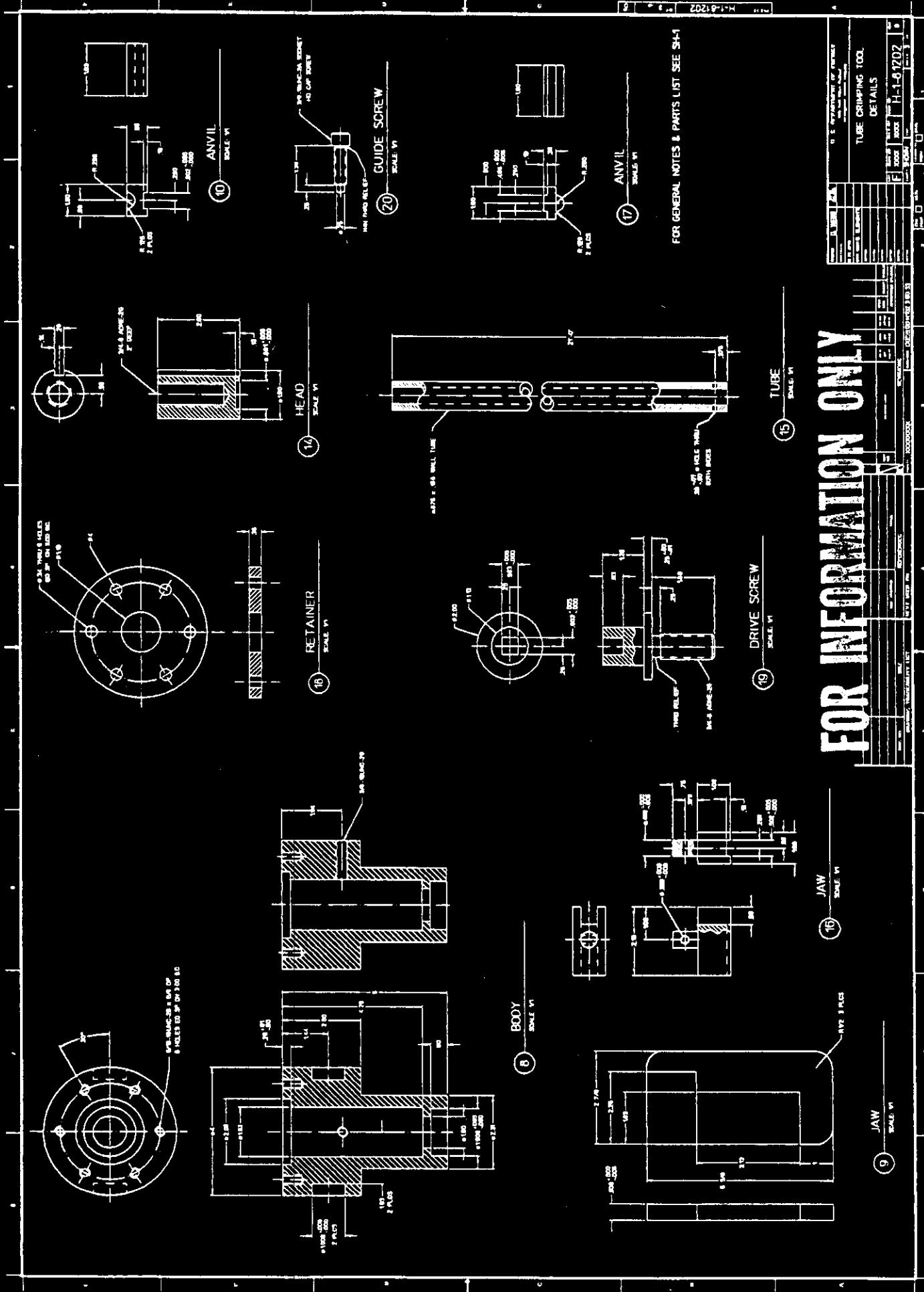
✓ 4. ALL MACHINED FELT FLOOR SHALL BE 10' MAX.

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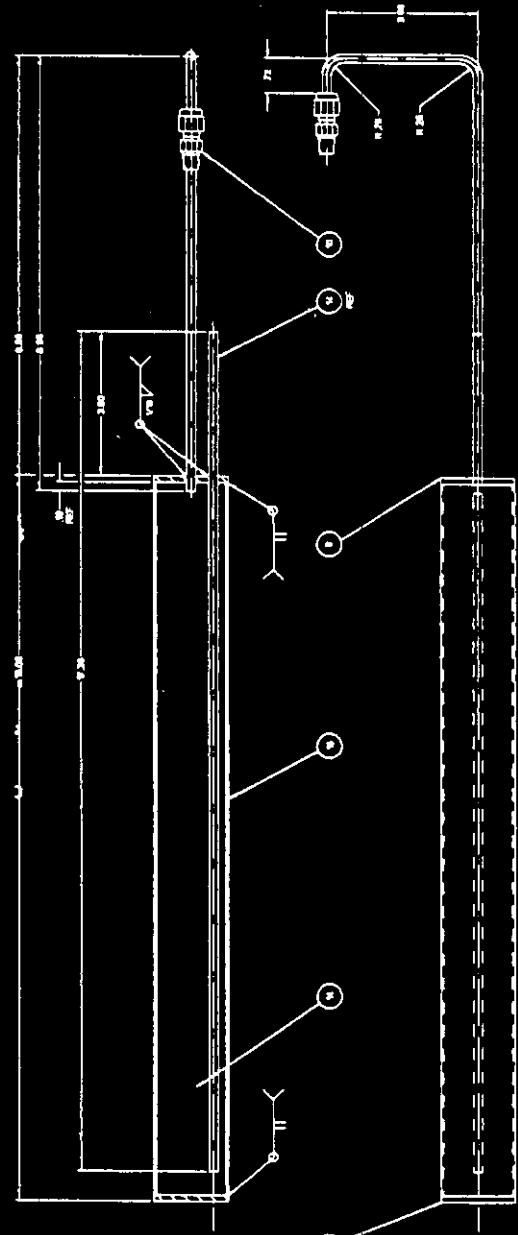
3 SUB-ASSEMBLY DRIVE  
SALE 41

1





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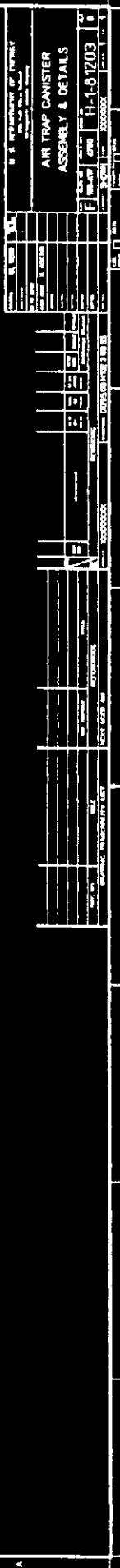
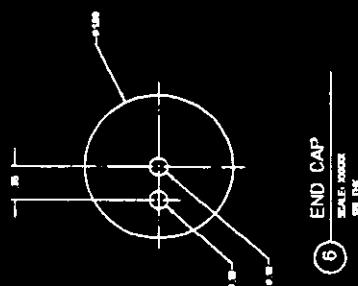
## GENERAL NOTES EXCLUSIONS WHERE SPECIFIED

1. DIMENSIONING AND TOLERANCING FOR ASME Y14.5  
DIMENSIONS AND TOLERANCES

2. TOLERANCES: FUNCTIONAL + VIB  
DEACTIVATED, AP = 100, 1000 = 400  
APPROX. AP

3. ALL WORKED SURFACES  $\Rightarrow$  OR BETTER IN ACCORDANCE  
WITH ASME 10.0 LATEST REVISION

4. FOR ALL DRAWN SURFACES AND REINFORCING ALL SURFACES  
5. IN PRACTICAL WORK, SURFACES ARE NOT DRAWN



**GENERAL NOTES** UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS ARE IN INCHES.

2. TO ENGINE: FRONTRIGHT, 1 1/8" REAR, 1 1/2".

3. DECKED, 30" - 40".

4. ANALOGUE.

5. ALL MACHINED SURFACES ARE IN ACCORDANCE WITH ASME Y14.5M, LATEST EDITION.

6. ALL MACHINED SURFACES ARE TO BE FINISHED WITH A MAXIMUM ROLLER DIA. OF 0.0005" INCHES.

7. BREAK ALL CHAMPS AND REMOVE ALL SURFACES.

8. ALL MACHINED MACHINING SHALL BE AS SHOWN.

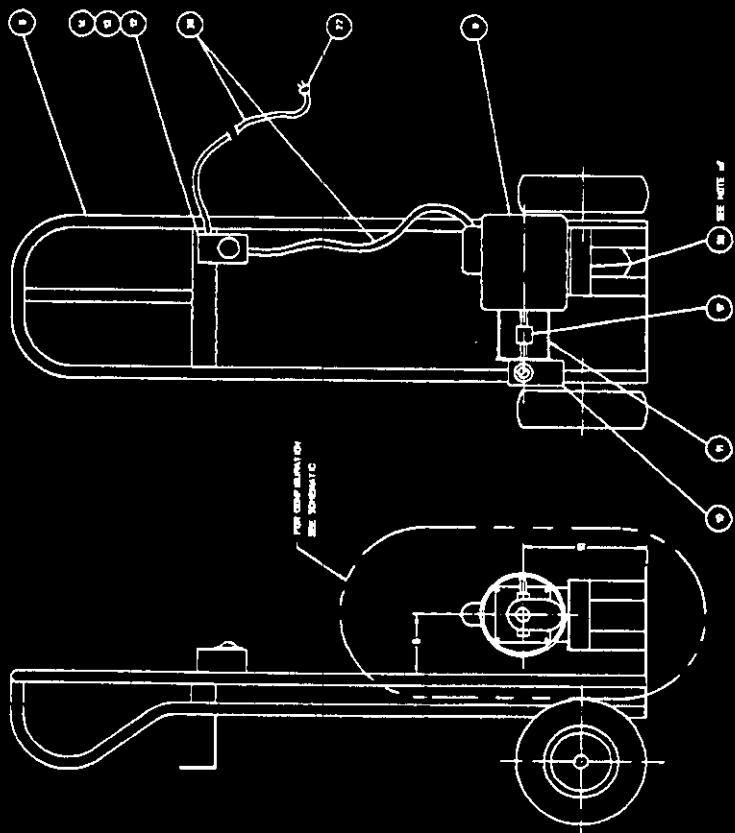
9. MOTOR, GENERATOR, START, 1/2 HP, 115 VAC, 60 CYCLES.

10. LENGTH TO BE, INCLUDED TO CENTER LINE, 40".

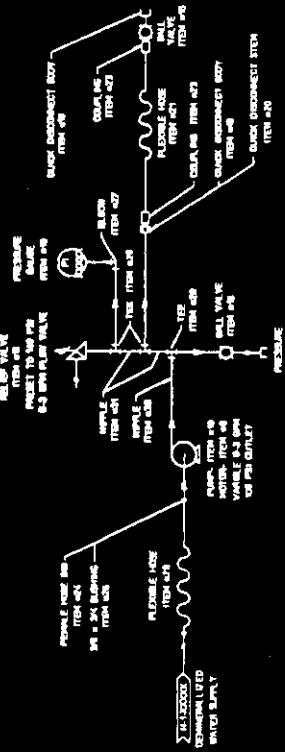
11. LENGTH TO CENTER LINE OF LARGEST ITEM, 40" MAX. NO. 10-12 GA. STEEL.

12. LENGTH TO CENTER LINE OF LARGEST ITEM, 40" MAX. NO. 10-12 GA. STEEL.

13. LENGTH TO CENTER LINE OF LARGEST ITEM, 40" MAX. NO. 10-12 GA. STEEL.



ASSEMBLY  
1



## SCHEMATIC - PRESSURE SYSTEM CART

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|                            |   | Date 01/29/96 |                |  |  |
| Project Title/Work Order   |   |               | EDT No. 610195 |  |  |
| Spent Nuclear Fuel Project |   |               | ECN No.        |  |  |

| Name   | MSIN  | Text<br>With All<br>Attach. | Text Only | Attach./<br>Appendix<br>Only | EDT/ECN<br>Only |
|--|-------|-----------------------------|-----------|------------------------------|-----------------|
| <b><u>U.S. Department of Energy,<br/>Richland Field Office</u></b> |       |                             |           |                              |                 |
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| G. D. Trenchard  | S7-41 | X                           |           |                              |                 |
| <b><u>Pacific Northwest Laboratory</u></b>                         |       |                             |           |                              |                 |
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| <b><u>Mac Technical Services Company</u></b>                       |       |                             |           |                              |                 |
| G. Baston  | R3-82 | X                           |           |                              |                 |
| <b><u>Mollerus Engineering Corporation</u></b>                     |       |                             |           |                              |                 |
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| Name   | MSIN  | Text<br>With All<br>Attach.  | Text Only                 | Attach./<br>Appendix<br>Only |
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