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RTNS-II OPERATIONS GUIDEBOOK

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RTNS-II OPERATIONS GUIDEBOOK

by

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Section A

Introduction

February 22, 1985

I. INTRODUCTION

- A. This guidebook is intended primarily for use by the operations group at RINS-II. It is intended to provide training criteria, procedures and guidelines for operation of the RINS-II neutron sources and ancillary equipment. Use of this document requires full knowledge of the RINS-II Facility Safety Procedure (FSP) and any Operational Safety Procedures (OSP) in effect. The RINS-II FSP defines the hazards which may be encountered at RINS-II and defines the procedures which must be followed in performing any task including operations.

The purpose of this document is to provide a central source of detailed information concerning systems and equipment used in operating the RINS-II neutron sources on a day-to-day basis. All members of the Operations Group are expected to be familiar with its contents. It is also intended to be used in training new members of the Operations Group.

Each section of this guidebook is dated individually and is subject to revision at any time. Section II supercedes UCID 1466.

- B. This guidebook was written with the help of the RINS-II staff. I would like to acknowledge the help of the Electronics and Operations Groups in particular.

Section B

Operator Training Program at

RINS-II

February 22, 1985

The training program for candidate accelerator operators at RINS-II has five parts.

- I. Orientation
- II. Instruction
- III. Observation of Operations
- IV. Supervised Operations
- V. Demonstration of Skills and Certification for Operations

I. ORIENTATION

Orientation will first consist of a building tour and description of the facility. During orientation the candidate will become familiar with the material in the RINS-II FSP, and all other procedures and guidelines relevant to RINS-II safety and operations contained in the RINS-II Operations Guidebook. Briefings or lectures may be used in place of or supplement the above. The following areas of information will be covered:

- A. Interlock systems
 1. Personnel safety interlock system
 2. Water interlock system
 3. Target interlock system
 4. Vacuum interlock system
 5. High voltage interlock system
- B. Radiation Monitoring Systems
 1. Tritium monitoring system
 2. RAM system
 3. Tritium swipe counting system
- C. Rotating Target Assembly
 1. 50-cm targets
 2. Vacuum seal and associated equipment
 3. Target controller
 4. Chilled water system
- D. Personnel Dosimetry
 1. TLD's
 2. Bioassay
 3. Radiation detection instruments
 - a) Induced activity detection
 - b) Tritium detection
 - c) Alarming dosimeters
 4. Doselog and release form
 5. Whole body counting

- E. Anti-Contamination Protection
 - 1. Protective clothing
 - 2. Respirators
 - 3. Authorization and sign-in requirements
- F. Radioactive Materials
 - 1. Handling
 - 2. Storage
 - 3. Movement within the RINS-II RMA
 - 4. Disposal
- G. Tritium Scrubber System
 - 1. Operation
 - 2. Maintenance
 - 3. Molecular Sieve Disposal
- H. Personnel Access Control
 - 1. RMA
 - 2. Interlocked areas

II. INSTRUCTION

- A. Courses Required (or have demonstrated equivalent experience)
 - 1. H.S. 660 - Radiation Detection Instruments
 - 2. H.S. 569 - Crane Safety
 - 3. H.S. 160 - Emergency Aid
 - 4. H.S. 601 - Radiation Safety Orientation
 - 5. H.S. 164 - Cardiopulmonary Resuscitation
- B. Courses Required (before working on open target system)
 - 1. H.S. 442 - Half- and Full-Face Mask Respirator Training
- C. Courses - Optional (but recommended)
 - 1. H.S. 462 - Respirator Protection
 - 2. H.S. 562 - Fork Truck Safety
 - 3. H.S. 520 - Laser Safety
 - 4. H.S. 168 - Fire Extinguisher
 - 5. H.S. 522 - Electrical Hazards Awareness
 - 6. H.S. 503 - Pressure Safety Orientation
- D. Each candidate will attend the Radiation Safety Lecture for the RINS-II facility. (An individual briefing may replace this requirement.)
- E. Each candidate will complete a course in vacuum technology or have equivalent experience.
- F. Each candidate will become knowledgeable in vacuum leak detection methods or have demonstrated experience.
- G. Each candidate will be briefed on neutron source theory, and on the rotating target assembly.

III. OBSERVATION OF OPERATIONS

Each candidate will observe operation of the neutron sources and auxiliary equipment for a minimum period of forty hours. During this period, the candidate will become familiar with the following:

- A. Ion Source Operation
 - 1. Start-up
 - 2. Shut-down
 - 3. Control and tuning parameters
 - 4. Interlocks/alarms
 - 5. Periodic maintenance/checks
 - 6. Vacuum system

- B. Haefely Equipment
 - 1. Start-up
 - 2. Shut-down
 - 3. Periodic maintenance/checks
 - 4. Interlocks/alarms

- C. Beam Transport System
 - 1. Interlocks
 - 2. Control and tuning parameters
 - 3. Vacuum system
 - 4. Periodic maintenance/checks

- D. Rotating Target System
 - 1. Start-up
 - 2. Shut-down
 - 3. Interlocks/alarms
 - 4. Vacuum system (including differential pumps)
 - 5. Target controller (rotation and scan)
 - 6. Target-chilled water system
 - 7. Oil mister
 - 8. Target change procedures
 - 9. Periodic maintenance/checks

- E. Tritium Scrubber System
 - 1. Operation
 - 2. Periodic maintenance/checks
 - 3. Alarms

- F. Data Recording System
 - 1. Start-up (ND and CAMAC)
 - 2. Shut-down (ND and CAMAC)
 - 3. Parameter entry and change
 - 4. Neutron monitoring

- G. LCW Cooling System
 - 1. Interlocks/alarms
 - 2. Periodic maintenance/checks
- H. Interlock System Check
- I. Radioactive Materials
 - 1. Proper handling and movement
 - 2. Proper storage
 - 3. Proper disposal
 - 4. Decontamination
 - 5. Anti-contamination protection
 - 6. Swipe counting
 - 7. Radiation surveying
 - 8. Waste water system
- J. Tritium Monitoring
 - 1. Exhaust fans
 - 2. Monitors
 - 3. Alarms
 - 4. Periodic maintenance/checks
- K. Experiment Set-up

IV. SUPERVISED OPERATING

Each candidate will operate the neutron source and auxiliary system for a minimum of two weeks under close supervision of a qualified operator. This period is to be "hands on".

V. DEMONSTRATION OF SKILLS AND CERTIFICATION

The Accelerator Physicist and Lead Operator will observe the candidate during the above-mentioned "hands on" training and make a determination of qualification or necessary extension of the training period. *Certification will be documented and a copy placed in the Bldg. 292 files.* Certification is subject to review at any time. Any operator who is inactive at RINS-II for a period of one year must be recertified.

Section C

RINS-II Guide to Function, Location and Control of:

Water Valves
Vacuum Valves
Thermocouple Gauges
Ion Gauges
Water Flow Switches

February 22, 1985

Water Valves

| Label | Function | Location | |
|-------|---|-------------------------------|-------------------------|
| | | Control | Physical |
| V1 | Ion source water valve | Term water map | Bend mag stand Term. |
| V2 | Bend mag water valve | Term water map | Bend mag stand Term. |
| V3 | Source and plenum turbo pump water valve | Term turbo pump controls | Bend mag stand Term. |
| V11 | LCW supply to terminal | Control Room water map | Below Mezz. |
| V12 | LCW return from terminal | Control Room water map | Below Mezz. |
| V13 | LCW supply to beam tran. sys. | Control Room water map | Below Mezz. |
| V14 | LCW return from beam trans. sys. | Control Room water map | Below Mezz. |
| V15 | LCW supply to mezzanine turbos | Turbo control Control Room | On Mezz. |
| V16 | LCW supply to Target Room turbos | Turbo control Control Room | Above Mezz. |
| V17 | LCW supply to target cart | Control Room water map | Above Mezz. |
| V18 | LCW return from target cart | Control Room water map | Above Mezz. |
| V19 | Not used | | |
| V20 | Not used | | |
| V21 | Not used | | |
| V22 | Target chilled water return | Control Room target chain | Below Mezz. |
| V23 | Target chilled water supply | Control Room target chain | Above Mezz. |

Term. = High Voltage Terminal - Machine Room

Mezz. = Mezzanine - Machine Room

Vacuum Valves

| Label | Function | Location | |
|-------|---|---------------------------------------|----------------------------|
| | | Control | Physical |
| V1 | Roughing by-pass - Source turbo | Terminal vac map | Term. |
| V1a | Roughing by-pass - Plenum turbo | Terminal vac map | Foreline Term. |
| V2 | Source turbo fore vac valve | Terminal vac map | Foreline Term. |
| V3 | Source and plenum turbo auto vent valve | Turbo pump controllers | On source turbo |
| V4 | Beam line gate valve | Terminal vac map | Below ion source Term. |
| V5 | Beam line gate valve | Terminal and Control Room vac maps | Accel. tube entrance Term. |
| V6 | Vent valve source | Terminal vac map | Bending mag chamber Term. |
| V7 | Vent valve - Term. forepump | Terminal vac map | Foreline Term. |
| V8 | Source gas valve | Terminal and ion source control panel | Hot rack Term. |
| V10 | Source vent valve | Manual | Ion source Term. |
| V11 | Source roughing valve | Manual | Foreline Term. |
| V12 | Plenum turbo fore vac valve | Terminal vac map | Foreline Term. |
| V15 | Accel. tube roughing by-pass | Control Room vac map | On Mezz. |
| V16 | TP1 turbo fore vac valve | Control Room vac map | On Mezz. |
| V17 | TP2 turbo fore vac valve | Control Room vac map | On Mezz. |
| V18 | Beam line gate valve | Control Room vac map | On Mezz. |
| V19 | Target Room turbo fore vac valve | Control Room vac map | Below Mezz. |
| V20 | TP3 turbo fore vac valve | Control Room vac map | Target Room |
| V21 | TP4 turbo fore vac valve | Control Room vac map | Target Room |
| V22 | Target roughing valve | Control Room vac map | Below Mezz. |

Vacuum Valves

| Label | Function | Location | |
|-------|----------------------------------|---------------------------|-------------|
| | | Control | Physical |
| V23 | Beam line gate valve | Control Room vac map | Target Room |
| V24 | Vacuum pump exhaust to stack | Control Room vac map | Below Mezz. |
| V25 | Vacuum pump exhaust to scrubber | Control Room vac map | Below Mezz. |
| V26 | TP1, TP2, auto vent valve | Turbo pump controllers | On TP1 |
| V27 | TP3, TP4 auto vent valve | Turbo pump controllers | On TP3 |
| V28 | Vent valve - accel. tube | Control Room vac map | On Mezz. |
| V29 | Vent valve - beam transport | Control Room vac map | On Mezz. |
| V30 | Vent valve - target | Control Room vac map | Below Mezz. |
| V31 | Vent valve - fore pump | Control Room vac map | Below Mezz. |
| V32 | Roughing bypass - target | Control Room vac map | Below Mezz. |
| V33 | Roughing bypass - beam transport | Control Room vac map | Below Mezz. |

Term. = High Voltage Terminal - Machine Room

Mezz. = Mezzanine - Machine Room

Thermocouple Gauges

| Label | Function | Location | |
|-------|---------------------------------------|--------------|------------------|
| | | Control | Physical |
| TC1 | Fore line TC gauge | Terminal | Foreline Term. |
| TC2 | Source turbo TC gauge | Terminal | Foreline Term. |
| TC3 | Ion source TC gauge | Terminal | Ion source Term. |
| TC4 | Plenum turbo TC gauge | Terminal | Foreline Term. |
| TC6 | Beam trans. sys. forepump TC gauge | Control Room | Below Mezz. |
| TC7 | TP1, TP2 foreline TC gauge | Control Room | On Mezz. |
| TC8 | Beam trans. sys. TC gauge | Control Room | On Mezz. |
| TC9 | TP3, TP4 foreline TC gauge | Control Room | Below Mezz. |
| TC10 | Target TC gauge | Control Room | Target Room |
| TC11 | Target roughing line TC gauge | Control Room | Below Mezz. |
| TC26 | Outer differential groove | Control Room | On Mezz. |
| TC27 | Inner differential groove | Control Room | On Mezz. |

Term. = High Voltage Terminal - Machine Room

Mezz. = Mezzanine - Machine Room

Ion Gauges

| Label | Function | Location | |
|-------|--------------------------|--------------|-------------|
| | | Control | Physical |
| IG1 | Ion source turbo IG | Terminal | Terminal |
| IG2 | Term. plenum turbo IG | Terminal | Terminal |
| IG3 | Accelerator tube IG | Control Room | On Mezz. |
| IG4 | Beam transport system IG | Control Room | On Mezz. |
| IG5 | Target Room IG | Control Room | Target Room |

Mezz. = Mezzanine - Machine Room

Water Flow Switches

| Label | Function | Location | |
|-----------|--|---------------------------|---------------------------|
| | | Control | Physical |
| FS2 | Cathode | Water map Term. | Ion Source Stand Term. |
| FS3 | Zwischen electrode | " | " |
| FS4 | Anode electrode | " | " |
| FS5 | Source & shaping mag/reflector | " | " |
| FS6 | Accel/Decel/Gnd electrode | " | " |
| FS7 | Bend mag. coils & chamber | " | " |
| FS8 | Bend mag liner, 0° and 45° targets | " | " |
| FS9 | Solenoid lens | " | " |
| FS10 | Accel. tube entrance elect. and plunging target | " | " |
| FS11 | Source & plenum turbos | " | " |
| FS12 | TP1, TP2 turbo pumps | Control Room water map | On Mezz. |
| FS13 | Anode accel. col. | " | " |
| FS14 | Plenum collimator | " | " |
| FS15 | Mezzanine quad beam pipe | " | " |
| FS16 | Camera box | " | " |
| FS17 | Wall beam pipe TG Room quad | " | " |
| FS18 | Copper pipe | " | " |
| FS19 | Accelerator tube | " | " |
| FS20 | TP3, TP4 turbo pump | " | Below Mezz. |
| FS21 | Target cart water | " | On Mezz. |
| TCW Flow* | Target chilled water | On Mezz. | Control Room |

*TCW flow is included in the TCW flow readout unit in Control Room
 Term. = High Voltage Terminal - Machine Room
 Mezz. = Mezzanine - Machine Room

Section D

Guide to Interlocks and Interlock Chains

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I. INTRODUCTION

The guides on the following pages describe the interlocks and interlock chains in use on the RINS-II neutron sources. The description gives the interlocking element (what does the interlocking), the interlocked element (what is interlocked), the effect of the interlock (i.e. permissive, close valve, etc.), and the type of interlock (MP = primarily for neutron source protection, PP = primarily for personnel protection). Only the primary interlocked elements are given (i.e. an interlocking element may have an effect on several elements).

In any display panel containing interlock indicators, the following convention holds

| | |
|-------------|----------------------------|
| white light | - control power on |
| red light | - interlocking element |
| amber light | - indicator light only |
| green light | - interlock chain complete |

Guide to Water Interlocks (Terminal)*

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|-----------------------------|--|--------------------------------------|-------------|
| FS1 | Extraction power supply | Power supply off | MP |
| FS2 | Hot rack power Decel | Power off Power off | MP/PP |
| FS3 | Hot rack power Decel | Power off Power off | MP/PP |
| FS4 | Hot rack power Decel | Power off Power off | MP/PP |
| FS5 | Hot rack power Decel | Power off Power off | MP/PP |
| FS6 | Hot rack power Decel | Power off Power off | MP/PP |
| FS7 | Hot rack power Decel | Power off Power off | MP/PP |
| FS8 | Hot rack power Decel | Power off Power off | MP/PP |
| FS9 | Lens magnet power | Power off | MP |
| FS10 | Hot rack power Decel | Power off Power off | MP/PP |
| FS11 | Source turbo pumps Plenum turbo pumps | Turbo pumps off and starts auto vent | MP |

*Part of terminal interlock chain

Guide to Vacuum Interlocks (Terminal)*

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|-----------------------------|---|--|-------------|
| TC1 | V2, V12 V1, V1A | Close V2, V12 Permissive to open | MP MP |
| TC2 | V2, V4 Source plenum turbo H ₂ O V3 | Close V2, V4 Turbos off & start auto vent close V3 | MP |
| TC3 | V4, V8 | Close V4, V8 | MP |
| TC4 | V12, V4 Source plenum turbo H ₂ O V3 | Close V12, V4 Turbos off & start auto vent Close V3 | MP MP |
| IG1 | V5 | Close V5 | MP |
| IG2 | V5 | Close V5 | MP |
| V4* | Hot rack power | Power off | MP |
| V5* | Bend magnet | Power off | MP |

*Part of terminal interlock chain

Guide to Terminal Isolation Rack Interlock Chain*

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Type</u> | |
|---|----------------------------|-----------------------|----|
| Ion source H ₂ O flow Summation of FS2-8, FS10 | Isolation rack power | Power off | MP |
| Bend magnet H ₂ O flow | Isolation rack power | Power off | MP |
| V4 | Isolation rack power | Power off | MP |
| Roof fans | isolation rack power | Power off | MP |
| Terminal door closed | Isolation rack power | Power off | PP |
| Door bypassed (maintenance mode) | None | Indicator only | PP |

*Isolation rack power on (chain complete) has a 20-second delay to allow time to exit terminal and close door.

Guide to Terminal Chain Indicator Lights*

| <u>Indicator Label</u> | <u>Meaning of Indicator</u> |
|-----------------------------------|--|
| Decel power | Power on to Decel power supply |
| Crowbar open | Crowbar to isolation rack open |
| HV control on | Extraction/Decel switch at control console on |
| Steerer power | Power on to steerer power supplies |
| Bend magnet power | Power on to bend magnet power supply |
| Bend magnet H ₂ O flow | Bend magnet H ₂ O flow switch made up |
| V5 open | V5 gate valve open |
| Beam line gate valves | V18, V23 gate valves open |
| Lens power | Power to solenoid lens power supply |
| Lens H ₂ O flow | Solenoid lens H ₂ O flow switch made up |

*These lights are indicators only. Indicator lights are amber colored.

Guide to Terminal High Voltage Interlock Chain

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|-----------------------------|----------------------------|----------------------------|-------------|
| Accelerator | Bend magnet | Power off | MP |
| H ₂ O flow | Isolation rack | Power off | MP |
| FS10, FS7 | Power | | |
| Mode switch | Bend magnet | Power off | MP |
| Normal (key A) | Solenoid lens | Power off | MP |
| | Hot rack crowbar | Crowbar | PP |
| | Decel | Power off | PP |
| | Cober power supply | Output off | PP |
| <i>Cober power supply</i> | <i>None</i> | <i>Indicator only</i> | <i>PP</i> |
| Ground hook stowed | Bend magnet | Power off | MP |
| | Solenoid lens | Power off | MP |
| | Hot rack crowbar | Crowbars | PP |
| | Decel power supply | Power off | PP |
| | Cober power supply | Output off | PP |
| Terminal door closed | Bend magnet | All power off | MP |
| | Solenoid lens | | MP |
| | Hot rack crowbar | | PP |
| | Hot rack power | | PP |
| | Decel power supply | | PP |
| | Cober power supply | | PP |

Guide to Water Interlocks (Beam Transport)*

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|-----------------------------|----------------------------------|----------------------------|-------------|
| FS12** | TP1, TP2 Haefely high voltage | TP1, TP2 off HV off | MP MP |
| FS13** | Haefely high voltage | HV off | MP |
| FS14** | Haefely high voltage | HV off | MP |
| FS15** | Haefely high voltage | HV off | MP |
| FS16** | Haefely high voltage | HV off | MP |
| FS17** | Haefely high voltage | HV off | MP |
| FS18** | Haefely high voltage | HV off | MP |
| FS19** | Haefely high voltage | HV off | MP |
| FS20** | TP3, TP4 Haefely high voltage | TP3, TP4 off HV off | MP MP |

* Part of Operational interlock chain.

** Flow switch summation is part of permissive to electron trap.

Guide to Vacuum Interlocks (Beam Transport)

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|----------------------------------|---|--|----------------|
| TC7 | V16, V17, TP1, TP2 | (Close V16, V17) TP1, TP2 off | MP |
| TP1, TP2 Controller Start/Bypass | V16, V17, TP1, TP2 | Permissive to open Permissive to start | MP |
| TC8 | TP3, TP4 | TP3, TP4 off | MP |
| TC9 | V19 | Close V19 | MP |
| TP3, TP4 Controller Start/Bypass | V19 TP3, TP4 | Permissive to open Permissive to start | MP |
| TC11 | V22 | Permissive to open | MP |
| IG3 | V18* | Close V18 | MP |
| IG4 | V18*, V23* | Close V18, V23 | MP |
| IG5 | V23* | Close V23 | MP |
| Blower pressure switch | TP1, TP2 TP3, TP4 | TP1, TP2 off TP3, TP4 off | MP |
| 3 psi pressure switch | V24 | Opens V24 to stack on forepump. Exhaust pressure high. | MP |
| V22 | V16, V17, V19 | Interlock element closes upon opening of interlocking element. Use caution on opening interlocking element | MP |
| V15 | V16, V17, V19 | | MP |
| V32 | V16, V17, V19 | | MP |
| V33 | V16, V17, V19 | | MP |
| V18*, V23* | Haefely high voltage bend magnet Arc | HV off power off Arc scram | MP MP MP |

*Part of operational interlock chain.

Guide to High Voltage Interlock Chain*

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|--------------------------------|----------------------------|----------------------------|-------------|
| Maintenance ground hook stored | Haefely high voltage | HV off | PP/MP |
| GW Ground hook stored | Haefely high voltage | HV off | PP/MP |
| Machine Room door closed | Haefely high voltage | HV off | PP |
| Target Room door closed | Haefely high voltage | HV off | PP/MP |
| HV crowbar closed | None | Indicator light only | PP/MP |
| HV crowbar air supply | None | Indicator light only | MP |
| HV crowbar open | Haefely high voltage | HV off | PP/MP |

*Permissive in operational interlock chain.

Guide to Run/Safe Interlock Chain

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|---------------------------------|---|--|----------------|
| Run/safe MR HV pit north | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Run/safe MR HV pit south | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Run/safe MR Mezzanine | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Run/safe MR southeast | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Run/safe MR south | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Run/safe MR door | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Run/safe TR interior | Haefely high voltage Arc | HV off Arc scram* | PP PP |
| Run/safe TR door | Haefely high voltage Arc | HV off Arc scram* | PP PP |
| Run/safe interlocks complete | Haefely high voltage Arc Operational interlock chain | HV off Arc scram* permissive in oper. interlock chain | PP PP PP |

*Arc scrams if plunging target out or quadrupole power supplies off when Target Room door open.

Guide to Operational Interlock Chain*

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|--------------------------------------|---|----------------------------|----------------|
| H ₂ O flow beam transport | Haefely high voltage Arc | HV off Arc scram | MP MP |
| Gate valves V18, V23 | Haefely High Voltage Arc bend mag | HV off Arc scram off | MP MP MP |
| Run/safe** Interlock chain | Haefely high voltage Arc | HV off Arc scram | PP PP |
| High voltage*** interlock chain | Haefely high voltage Arc | HV off Arc scram | PP |
| Remote area monitor power | Haefely high voltage Arc | HV off Arc scram | PP |
| Emergency switch**** | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Key A operate | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Warning horn (complete) | Haefely high voltage Arc | HV off Arc scram | PP PP |
| Key B operate | Haefely high voltage | HV off | PP |
| Operational interlocks complete | Haefely high voltage | HV off | PP |

*Operational interlock chain part of total interlock chain

**Summation of run/safe interlock chain

***Summation of high voltage interlock chain

****Switch breaks interlock chain but has no indicator light

Guide to Target Interlock Chain*

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|--|---------------------------------|------------------------------|-------------|
| Target cart Water FS 21 | Target controller (Rotation) | Rotation off | MP |
| Oil mist | Target controller (Rotation) | Rotation off | MP |
| Lift-off Air | Target controller (Rotation) | Rotation off | MP |
| Target H ₂ O Flow (low) | Target controller (Rotation) | Rotation off For low flow | MP |
| Target H ₂ O Flow (high) | None | Alarm only | MP |
| TCW Pump | Target controller (Rotation) | Rotation off | MP |
| TCW compressor #1 | None | Indicator light only | MP |
| TCW compressor #2 | None | Indicator light only | MP |
| Target rotation High | Target controller | Rotation off | MP |
| Target rotation Low | Haefely high voltage | HV off | MP |

*Target interlock chain part of total interlock chain

Guide to Total Interlock Chain

| <u>Interlocking Element</u> | <u>Interlocked Element</u> | <u>Effect of Interlock</u> | <u>Type</u> |
|--|--------------------------------|--------------------------------|-------------|
| Operational inter- lock chain complete | Haefely high voltage | HV off | PP |
| High voltage inter- lock chain complete | Operational interlock chain | HV off Ar: scram | PP PP |
| Target interlock complete | Haefely high voltage | HV off | MP MP |
| Total interlocks complete | Haefely high voltage | HV off | PP |

Section E

Guide to Remote Area Monitoring (RAM) Units

February 22, 1985

I. INTRODUCTION

RAM units for detecting prompt or induced radiation are located at the following locations:

- A. Left Machine Room
- B. Left Target Room door
- C. Left Target Room door fence position
- D. Power Supply Room rack
- E. Hot Work Room door
- F. Target Storage Vault door
- G. Right Machine Room
- H. Right Target Room door fence position

The local control units for the RAMS are located in the Control Room. These have logarithmic analogue meters which indicate radiation levels at the various locations. There are also two or three alarm level adjustments which set the low, intermediate (if applicable) and high levels. Associated with these levels are amber, blue (if applicable), and red lights. The levels set are indicated by the appropriately colored dials. An amber light on a Control Room unit means possible RAM unit failure and alarms in the Control Room (see Guide to Alarms at RINS-II). RAM units C, D, E, F and H (see above) also have analogue readouts at the detector location (remote). They also have light indicators (amber and red) and an audible alarm. The audible alarm is connected to the red light. Units C, D, E and F indicate (at the remote location) intermediate levels by the amber light and high levels by the red light and audible alarm.

During normal operation (beam to target) the Machine Room RAM units will read high levels of radiation (~1000 mR/hr). This is normal. A high level signal from any RAM unit drives the blue rotating beacons on the building roof. RAM unit power is in the Operational Interlock Chain (see Guide to Interlocks and Interlock Chains - Section D-12). The RAM units at RINS-II are maintained and calibrated by Plant Engineering Personnel.

RAM Units at RINS-II

| <u>RAM Unit</u> | <u>Readout L/R*</u> | <u>Type of Alarm</u> |
|--|---------------------|---------------------------------|
| Left Machine Room | L | Lights (3) |
| Left Target Room door | L | Lights (3) |
| Left Target Room door Fence position | L R | Lights (3) Light and audible |
| Power Supply Room rack | L R | Lights (3) Light and audible |
| Hot Work Room door | L R | Lights (3) Light and audible |
| Target Storage Vault door | L R | Lights (3) Light and audible |
| Right Machine Room | L | Lights (2) |
| Right Target Room door Fence position | L R | Lights (2) Light and audible |

*L = Local, R = Remote

Section F

Guide to Neutron Source Alarms

February 22, 1985

I. INTRODUCTION

This guide describes the alarms in use at KINS-II to indicate abnormal conditions (i.e. alarms are not activated under normal conditions). All alarms have at least indicator lights. Some may also have audible signals also. To the extent possible (exceptions are noted), the following convention holds

amber light - abnormal conditions but no interlock function
red light - abnormal condition with interlock function (i.e. the alarming element is also an interlocking element; see Guide to Interlocks and Interlock Chains, Section D)

Because each alarm indicates an abnormal condition, the cause of each alarm should be investigated and remedial action taken. Alarms should not be left in the activated mode for long periods unless there is good reason and such reason is noted in the log book.

Terminal Alarms

| <u>ALARM</u> | <u>ALARM FUNCTION</u> | <u>TYPE OF ALARM</u> |
|--------------|---------------------------|----------------------|
| TC 1 | Fore pump fore vac bad | Light (red) |
| TC 2 | Source turbo fore vac bad | Light (red) |
| TC 3 | Ion source pressure bad | Light (red) |
| TC 4 | Plenum turbo fore vac bad | Light (red) |

Neutron Source Alarms (Control Room)

| ALARM | ALARM FUNCTION | TYPE OF ALARM |
|--|---|---|
| TC 6 | Mezz forepump pressure bad | Light (amber) |
| TC 7 | TP1, TP2 fore vac bad | Light (red) |
| TC 8 | V18 to V23 pressure bad | Light (red) |
| TC 9 | TP3, TP4 fore vac bad | Light (red) |
| TC 10 | Target pressure bad | Light (amber) |
| TC 11 | Target roughing line pressure bad | Light (red) |
| TC 26 | Target outer groove pressure bad | Light (amber) |
| TC 27 | Target inner groove pressure bad | Light (amber) |
| 3 psi over pressure | Mezz forepump exhaust pressure high | Light (red) |
| Decel Alarm | Ion source Decel current high | Flashing light (amber) & audible |
| Isolation transformer over temperature | Haefely isolation transformer Temperature high | Flashing light (amber) & audible |
| High voltage off | Haefely high voltage off | Flashing light (amber) & audible |
| Target water flow high | Target H ₂ O flow >20 gpm | Flashing light (amber) & audible |
| Humidity high | Machine Room Humidity high | Flashing light (amber) |
| Temperature high | Machine Room Temperature high | Flashing light (amber) |
| Stack flow velometer* | Main stack air flow Low | Light (amber) |
| Flow alarm* Left Target Room Right Target Room Hood & storage vault | Air flow low | Light (amber) Flashing light (amber) & audible |
| Pl Alarm* | Pump for stack tritium Monitor not on | Light (amber) Flashing light (amber) & audible |
| Tritium Monitors* 1-9, 11 low high | Exceeded low alarm setting Exceeded high alarm setting | Light (amber) Light (amber) Flashing light (amber) & audible |

| ALARM | ALARM FUNCTION | TYPE OF ALARM |
|---|--|--|
| Pressure transducer* | | |
| Low | Tritium scrubber input pressure low | Light (amber) |
| High | Tritium scrubber input pressure high | Light (red) Flashing light (red) & audible |
| Tritium scrubber Input pressure Low or high | as previous one | Lights (amber) & audible |
| Scrubber flow Low or high | Mass flow outside limits | Lights (amber) & audible |
| Scrubber blower suction Low or high | Blower suction Outside limits | Lights (amber) & audible |
| Scrubber HTR temp Low or high | Catalytic converter Temp low or high | Lights (amber) & audible |
| Sample short Left or right | Target sample contact Left or right machine | Lights (amber) & audible |
| Gamma system power | RAM units Power off | Light (red) & audible |
| Low coolant flow** | TCW flow Low | Light (amber) |
| Compressor malfunction** | TCW compressor failure | Light (amber) |
| Low coolant level** | TCW chiller water Level low | Light (amber) |

* Alarms on tritium monitor map are not interlocked

**Alarms on target water chiller control

Section G

Periodic Check and Maintenance Schedule

February 22, 1985

- I. This procedure defines general guidelines for frequency of periodic status checks and/or maintenance of the RNS-II neutron sources. These are guidelines only and do not preclude more frequent or "as needed" maintenance and checks. Unless otherwise noted, these are the responsibilities of the operations staff. All checks and/or maintenance should be recorded in log book and initialed. An initialed log book entry is required each day, each shift.
- II. Daily
 - A. Status of all vacuum systems
 - B. Status of all doors and gates
 - C. Status of tritium scrubber and tritium monitor alarms
 - D. Haefely motor generator hours for lubrication needs
 - E. Status of exhaust fan flows (particularly main stack)
 - F. Status of any interlock "buggers" in system
- III. Weekly
 - A. Change ion source filament as needed.
 - B. Surge resistor and diode strings on Haefely (Electronics Technicians)
 - C. Target oil mister levels and pressure
 - D. Target chilled water level
 - E. Target differential pump oil level
 - F. Target differential pump belts
 - G. Tritium scrubber sieves
 - H. Ion source gas bottle pressure
 - I. Accelerator column water hoses
 - J. Mezzanine and terminal turbo and forepump/blower oil levels
 - K. Tritium monitor alarm set points (H/S Technician)
 - L. Status of leak checkers

IV. Monthly

- A. Baefely isolation transformer fans
- B. Target chilled water make-up cartridges
- C. High voltage pit sump pumps
- D. LCW water filters
- E. Target chilled water filters
- F. Target chilled water skimmer cartridges
- G. Column resistors (Electronic Technicians)
- H. Change differential pump hoses during target change.

V. Semi-Annually

- A. Turbo pump oil change

VI. Annually

- A. Turbo pump bearing change (Mechanical Technicians)

VII. At Target Change

- A. Target room turbo oil level
- B. Condition of differential pump hoses
- C. Target air and water lines
- D. Beam current pick-off lead
- E. Position of PRC counters and ion chambers
- F. Carbon fiber composite target ring
- G. Oil mist collector level

Section H

Loss of Vacuum

February 22, 1985

Recovering From Loss of Vacuum at RINS-II

This procedure describes general guidelines to aid in the restart of vacuum systems after a neutron source vacuum loss.

- I. In the case of a vacuum burst in which the beam line gate valves close (V5, V18, V23), and fore vac valves (V16, V17, V19) close the following steps should be taken:
 - A. Assume the possible leak is due to water.
 - B. Scram the Arc (if not already done by automatic shutdown of terminal by vacuum burst).
 - C. Immediately stop target rotation.
 - D. Secure target chilled water system after target rotation stops.
 - E. Turn off ICW to mezzanine (V12, V14 on water map).
 - F. Turn off target cart water (V17, V18 on water map).
 - G. Assuming terminal has also gone to air, proceed to secure terminal by first shutting off ion source water (V1 and V2 terminal water map).
- II. The two most probable sources of water leaks are in the
 - A. Target area
 - B. Ion source area in the high voltage terminal
- III. To determine the possible causes of a vacuum problem, examine all exterior components such as ion gauges, windows, etc. in the terminal and on the mezzanine for evidence of cracking. This may also show evidence of water inside the vacuum system. Examine the terminal and mezzanine forepump/blowers for evidence of "frothy" oil which may indicate water in the oil. If this examination reveals no evidence of problems, the recovery of the vacuum system should be undertaken in stages. In all the following discussions, recall certain valves are interlocked to TC gauges which will require resetting limits to open the valves.

IV. ACCELERATOR TUBE VACUUM RESTART

- A. Under the assumption that the vacuum burst also closed all fore valves determine that the fore vacuums for the mezzanine turbo pumps are acceptable (TC6 and TC7). If they are not, this may indicate an external vacuum leak between the mezzanine forepump/blower and the fore vacuum valves or water in the fore lines. Large amounts of water in forelines will be evidenced by chilling or even frosting of forelines and/or bellows.
- B. If the fore vacuums are acceptable proceed to roughing bypass on the accelerator tube (open V15).
- C. If TC7 indicates the accelerator tube is pumping down, you can proceed to full roughing (TC7 reset V15 closed, V16 and V17 open).
- D. TC7 should drop to about 200 milli-torr.
- E. At this point, the mezzanine turbo pumps (TP1 and TP2) may be started.
- F. Reset limit on TC7.

V. TERMINAL VACUUM RESTART

- A. Make sure terminal fore vacuums are acceptable (TC1 and TC4).
- B. Make sure V4 is closed.
- C. Open roughing bypass valve (V1). Note this opens both V1 and V1A.
- D. If TC2 indicates bend magnet chamber is pumping down you can proceed to full roughing (close V1 open V2 and V12).
- E. After TC2 reads <200 milli-torr, the terminal turbo pumps can be restarted.
- F. Reset limits on TC1, TC2, TC4.
- G. Remember the ion source (above V4) in terminal is not yet pumped out. The ion source can be pumped out in the usual manner.

VI. BEAM TRANSPORT SYSTEM VACUUM RESTART BETWEEN V18 AND V23

- A. Close V18 and V23 if not already closed.
- B. Close V16 and V17 (fore vac valves for TP1 and TP2) if not already closed.
- C. Close V32 and V33 to the target if not already closed.
- D. Close V19 (TP3 and TP4 fore vac valve) if not already closed.
- E. Vacuum system between V18 and V23 is now isolated.
- F. Open V33 (beam transport system roughing bypass valve).
- G. After TC8 comes down to about 5000 milli-torr close V33 and open V19 (fore vac valve).
- H. After TC8 and TC9 drop below about 200 milli-torr, TP1 and TP2 can be turned on.
- I. After a few minutes, IG4 and IG5 can be used to determine condition of vacuum.
- J. Reset limits on TC7 and TC8.

VII. RESTART TARGET VACUUM SYSTEM

- A. V18 and V23 are assumed to be closed.
- B. Close V16, V17, and V19 (fore vac valves to TP1 - TP4). Ensure that V30 (target vent valve) is closed.
- C. Open V32 (target roughing bypass valve).
- D. If TC10 and TC11 drop to about 5000 milli-torr, close V32 and open V22 (target roughing valve).
- E. TC10 (target TC gauge) should drop to < 200 milli-torr. Note this may take several minutes.
- F. After TC10 < 200 milli-torr, close V22 and open V19. Then open V23 while holding V23 bypass button. If V23 does not stay open, check that IG4 and IG5 filaments are on. If not, turn filaments on and try V23 again.
- G. When V23 stays open, reopen V16 and V17 for TP1 and TP2.
- H. Remember that during the period V16, V17 and V19 are closed, there is no backing for TP1 - TP4. Be aware of the pressures at TC7 and TC9 if TP1 - TP4 are running.
- I. Reset limits on all TC gauges as necessary.

Section I

Use of Anti-Contamination Clothing

February 22, 1985

Use of Anti-Contamination Clothing at RINS-II

This procedure defines requirements for anti-contamination clothing when working in the RMA at RINS-II. Persons working under this procedure must be familiar with the RINS-II FSP or have the permission of the Health and Safety Technician.

I. TARGET ROOM ENTRY (authorization, two persons and log-in required)

Before entering Change Shed

- A. Foot Cover
 - 1. yellow booties inside; attached bunny suit booties next; hard-soled plastic booties outside (preferred method).
 - 2. yellow booties inside; attached bunny suit booties next; yellow booties outside.
- B. Body and head cover
 - 1. bunny suit with hood.
- C. Hand cover
 - 1. rubber gloves with wrists taped; a second pair of rubber gloves.
- D. Face cover
 - 1. respirator* when target system is open or as deemed necessary.

At the Change Shed

- E. Add a second pair of rubber gloves if not already done.
- F. Add an outside pair of booties if not already done.
- G. Change outer untaped rubber gloves frequently if hands are in contact with high tritium-contaminated parts (every 10-15 minutes).
- H. After completion of work, enter Change Shed and remove outer rubber gloves. Use inner pair of gloves to remove outer booties and bunny suit. Remove inner yellow booties, then gloves one at a time stepping out with the bare shoe onto clean asphalt area. Unprotected shoes should not contact floor of the Change Shed. Dispose of all protective clothing properly.
- I. For Target Room entry for minor adjustments etc., with target or vacuum system not open one person may enter the Target Room dressed as noted above provided a second person observes from the entrance to the Target Room. The observer must wear lab coat, rubber gloves and booties.

- J. To enter the Change Shed or concrete pad outside the Target Rooms requires booties, gloves and a lab coat. One person is sufficient. The Target Room door can be closed but must not be opened.
- K. Check hands and feet with hand and foot counter. Shoes must be swiped before leaving the RMA. If shoes cannot immediately be checked, white booties must be worn until such time as they can be checked. Note the hand and foot counter does not check for tritium, but is sensitive to TiF_2 particulate.

II. HOT WORK ROOM ENTRY (authorization, two persons and log-in required)

- A. For work in the hood on parts from the target or vacuum systems, the anti-contamination clothing requirements are the same as for Target Room entry.
- B. For Hot Work Room entry, which does not involve work in the hood or with targets, the required anti-contamination clothing is lab coat, booties, and rubber gloves. In this case, one person may observe from the entry door and is not required to wear protective clothing.
- C. Remove all protective clothing and dispose of properly in appropriate area of Hot Work Room before entering a defined clean area.
- D. Hand and foot checks are required before leaving the RMA (see section I.K above).

III. BOX CAR ENTRY (authorization, two persons and log-in required)

- A. The required anti-contamination clothing is lab coat, booties and rubber gloves.
- B. As for Hot Work Room entry, one person may observe from the door without protective clothing.
- C. Remove and dispose of all protective clothing at exit of boxcar.
- D. Hand and foot checks are required before leaving the RMA (see section I.K above).

IV. WORK ON VACUUM SYSTEMS IN MACHINE ROOM

- A. For the initial opening of any vacuum system (except the ion source), the required anti-contamination clothing is bunny suit, rubber gloves, and respirator.* For extended periods of work, the rubber gloves should be changed frequently.
- B. Booties are required as needed.
- C. For ion source work, a lab coat and gloves are required.
- D. Dispose of all protective clothing properly.
- E. Check hands and feet with hand and foot counter.

V. OTHER WORK

- A. Anti-contamination clothing requirements for other work will be determined on the basis of need after consultation with the Health and Safety Technician. However, use of gloves and lab coats is encouraged for all work on an RNS-II neutron source as a precautionary measure.
- B. Any protective clothing must be disposed of properly.
- C. Hand and foot checks may be required.

VI. TECHNIQUE

- A. When leaving a protective clothing area, observe the "change line" carefully. Don't step on the dirty side with your shoes on or the clean side with dirty booties.
- B. When removing protective gloves, coats and bunny suits, turn them inside out so as to contain any possible contamination more effectively.

* Respirators which can be used are:

- A. 3M 9940 (preferred)
- B. Norton 10030S, 10030M

All respirators must be fitted to determine proper size and sealing. All users must have a current laboratory training and fitting card. For hazardous non-routine operations a Health Physics and/or Industrial Hygienist will be consulted on breathing air protection. Non-disposable respirators can be worn after consultation with the Health Physicist concerning type.

Section J

Tritium Scrubber Maintenance/Checks

February 22, 1985

I. INTRODUCTION

This section describes the routine maintenance/checks to be performed on the tritium scrubber system to ensure proper operation. There are two scrubber units; one on-line, one on standby. A simplified schematic diagram is also given. Complete schematic diagrams are posted on tritium scrubber unit #1 in the Tritium Scrubber Room (Rm 1202) and at the tritium monitor rack in the Power Supply Room (Rm 1204).

The purpose of the tritium scrubber is to remove tritium from the vacuum system exhaust before the exhaust is sent to the main stack for release into the atmosphere. The tritiated hydro-carbon vapors in the vacuum system exhaust and bleed air (2 SCFH) from each terminal are first passed through particulate filters. They then pass through a catalytic converter which converts the tritiated hydrocarbons to tritiated water and/or water vapor. (The bleed air is used to improve the catalytic conversion process). After passing through a cooling loop, the tritiated water passes through a series of two molecular sieve beds which trap the moisture. Further air is mixed with the scrubbed exhaust before it is sent to the main stack for release.

A tritium monitor samples the processed exhaust between the two molecular sieve beds. This is used along with moisture indicators in the molecular sieves to indicate beginning of breakthrough of the first molecular sieve.

During pump-down of a vacuum system, various monitored functions of the tritium scrubber will alarm. The alarms (for the unit on line) which will activate under pump-down conditions are:

1. Scrubber Input Pressure - high alarm
2. Scrubber Flow - high alarm
3. Scrubber Blower Suction - low alarm

After a short period (about 2-3 minutes) these alarms will clear. These alarms are not activated under normal operating conditions. Therefore, an alarm under these conditions indicates a possible scrubber malfunction and should be investigated at once.

II. NOMINAL TRITIUM SCRUBBER MONITORED READINGS

The nominal readings for the monitored functions on a tritium scrubber (when in operation are:

| Monitored Function | Readout* Location | Nominal Reading | Alarm Set** | |
|-------------------------|-------------------|----------------------|---------------------|----------------------|
| | | | Low | High |
| Blower suction Pressure | In scrubber hood | 20" H ₂ O | 5" H ₂ O | 25" H ₂ O |
| Scrubber flow | Rack | 2500 sccm | 1000 sccm | 4000 sccm |
| Scrubber input*** | Rack | -(15-20) units | -80%FS | +50%FS |
| Converter temp. | Rack | 400°C | 200°C | 460°C |

*All readouts are in Tritium Scrubber Room (Rm 1202).

**Set points are on units in Tritium Scrubber Room (Rm 1202), Alarms are in Control Room (Rm 1000).

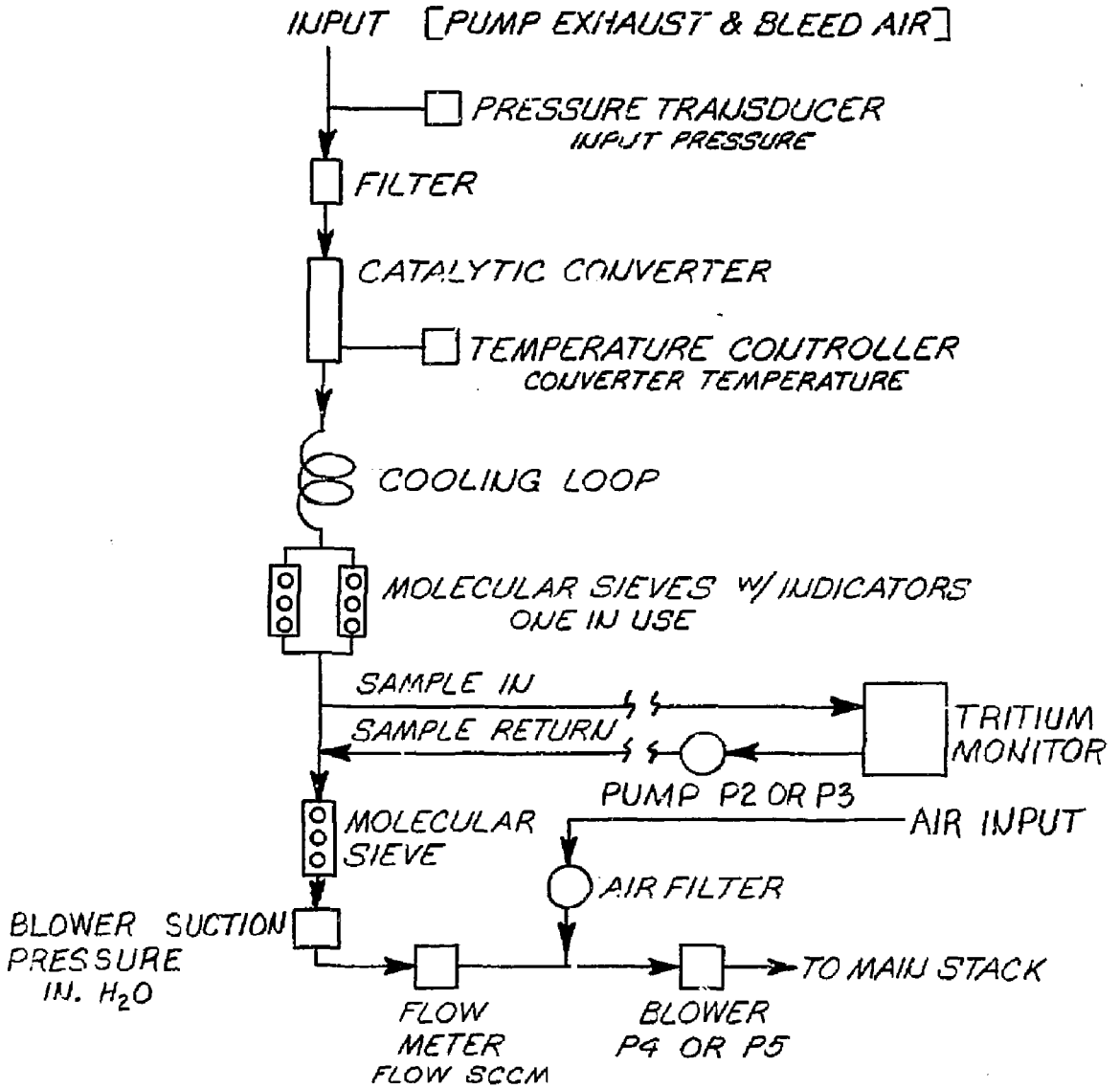
***Input pressure transducer is located in SE corner inside scrubber unit #1 hood. It is common to both scrubber unit input lines. Top scale reading on readout is from -100% to 100%. Bottom scale reading is from \pm 30 units FS where 30 is .5 psi (300 mm Hg).

III. SCRUBBER SIEVE REPLACEMENT

When a tritium monitor sampling a scrubber unit goes into alarm or when the moisture indicators in a sieve turn pink, this indicates the need for changing of the sieve. The following procedure should be used:

1. Lab coats and gloves must be used when working in a scrubber hood.
2. Valve in new sieve if appropriate (i.e. sieve to be changed is one of the two parallel sieves). Valve off sieve to be changed. (If sieve to be changed is the final sieve in the on-line scrubber, you should first put standby scrubber on line. Then valve off scrubber and sieve to be worked on.)
3. Remove and immediately cap used sieve.
4. Install new sieve.
5. Put used sieve in PVC pipe container and glue shut.
6. Ensure that you have normal readings on the on-line scrubber.
7. Place PVC-contained sieve in the labelled 55-gal. drum in RMA and recover drum.
8. If necessary, recheck for proper readings at scrubber and that appropriate valves are in proper position.

- SIMPLIFIED -
TRITIUM SCRUBBER DIAGRAM *



* NO VALVES ARE SHOWN

Section K

Typical Neutron Source Start-up Procedure

February 22, 1985

I. INTRODUCTION

In this section a typical start-up procedure is given for the Left Neutron Source. A similar procedure is used for the Right Neutron Source except where reference is made to specific rack or panel locations.

This procedure is not intended to be of the "check-list" type. It is rather intended to list "normal or usual" steps taken in starting a Neutron Source.

Control Room

- Read log book
 C-04 Check IG1 and IG2
 Check source and plenum turbo pumps "ON"
 C-01 Check vacuum system gauges IG3, IG4 and IG5
 Check turbo pumps "ON" TPL, 2, 3 and 4
 C-02 Remove key A from key lock panel

Machine Room

Open door latch and use key to open door
 Bring key with you when entering
 Make sure ground hooks are in place

Terminal

Turn on breakers 2 and 4 in panel 44049-9
 In rack 55 turn on all labeled breakers
 Turn on water V1 and V2 (HV term. water control map)
 Check that all flow meter lights made up
 Open gas valve V8. Re-check IG1 and IG2
 Open beam line valve V5
 Turn on all breakers for Cober P.S.
 Push system "ON" button on Cober and wait for current limit light to go out
 Push "RESET" button. "READY" comes on
 Insert key in "Maint. By-pass Mode" lock, turn key and hold down "Transfer" button and key "Operate ready" lock
 Remove ground hook and hang on interlock hanger by door
 Close terminal door and lock
 Move ladder to a spot by entry door

Mezzanine

Key "run/safe" box
 Close and latch gate upon leaving mezzanine
 Move mezzanine latter to west wall near entry door

H.V. Pit

If the red light on the SE corner is not flashing:
 Go down the ladder on south wall and check for personnel. If clear, key "run/safe" on north wall then key "run/safe" on east wall. Leave pit and close trap door

Closing Machine Room

Key SE "run/safe" box
 Move ground hook from base of terminal (NW corner) and place on microswitch hook in the floor
 Key SW "run/safe" box
 Move ground hook from OW tower & place on microswitch hook by entry door
 Key "run/safe" box by entry door
CHECK THAT NO ONE IS LEFT IN MACHINE ROOM—SHOUT: "CLEAR THE PIT"
 Close entry door and secure latch

CONTROL ROOM

- C-02 Insert key A in key slot A.
 C-01 Turn on beam transport water V14 and V13
 Turn on target cart water V18 and V17
 Re-check IG3, IG4 and IG5
 Open beam line valve V18
 C-03 Power up MG set
 C-02 When standby light is lit (green) next to key A - Turn key A and
 you should get a red "READY" light
 C-05 Turn on the two quad power supplies
 Turn on the two steerers
 If Target Room is open but ready to close:
 Remove key B from key lock panel and proceed to Target Room

TARGET ROOM

- Note: Booties, bunny suit, & rubber gloves are required for entry into Target Room (see Section I for authorization and clothing requirements)
 Check to see that no one is inside
 With Target Room clear, insert key and close door
 Close latch and remove key
 Insert key in gray box and make up interlocks
 Key "safe/run" box at the door
 Return to Control Room with key

CONTROL ROOM

- C-02 Insert key B in key slot B
 Target Water System
 C-02 Push TOW return valve button, TOW supply valve button and oil
 mist button "ON"
 C-09 If not already "ON", turn on pump and either compressor 1 or 2
 C-02 Check flow: should be ~12-15 gpm with no rotation
 Target Rotation
 Enable target controller
 Verify rotation and scan limits
 With rotation control in manual increase rotation speed to ~2/3
 of final valve and then switch to the auto mode for speed
 control. Observe that appropriate speed has been reached and is
 being controlled.
 Scan can be started as needed

CONTROL ROOM

Ion Source Start-up

- C-04 Push source gas button on remote control panel. Button should light up
Also, power, arc scram and plunging target buttons should be lit
- C-04 Check TV on left side of screen that chain and gas lights are lit. Also on the bottom of the screen that the turbos and V5 lights are lit
- C-04 The following components should already be set:
Source lens (≈ 75 volts), bending magnet (≈ 6.3 amps) and Steerer #1. (23).
- C-04 Remote Control Panel
Bring filament to 40 amps
Note: slowly, watch for outgassing
Bring gas to 1.5 units
Bring source to ≈ 1.5 amps
Bring shaping to 30 amps
Bring trim to 2.5 amps
Bring arc set to 2 volts

Striking Arc

- C-04 Un-scram arc by pressing the arc scram button and the arc should strike
If the arc doesn't strike, then press arc scram and raise the filament or gas up a little and try again
- C-04 Scram the arc and push decel button on (light lit). Raise decel to ≈ 3 kV and ext. volts to ≈ 32 kV.

Bring H.V. on

- C-02 Turn key B to "ON" (red ready light)
- C-03 Key on HV control panel
Turn on MG set (start lights)
Press manual restart button
After a "ON" light for MG set: press "Interlock" button
Press HV "ON" button
Turn on HV alarm

CONTROL ROOM

Timing Beam to Target

- C-04 Un-scram arc by pressing arc scram button (if the arc doesn't strike check "striking arc" section)
Check current on plunging target 20-50 ma.
- C-03 Check terminal plunging target monitor for beam centering
Check with experimenter before beaming to the target
Make sure the CAMAC and the ND systems are ready to go
- C-04 Remove plunging target. Check vacuum gauges.
Check plenum collimator current
Check target current and target collimator
Use the following to maximize beam current
1. Extraction voltage
 2. Source magnet
 3. Shaping magnet
 4. Trim magnet
 5. I.S. Steerer #1 and #2
- C-05 6. Quad mag. 1 and 2
- C-05 7. Steerers 1 and 2
- C-05 Check beam spot on TV for centering and size
- C-05 Increase beam current slowly with arc set I until you have desired current on target
- Note: Watch for target outgassing while increasing beam current on target

Section L
Tritium Monitoring System
February 22, 1985

I. INTRODUCTION

Tritium concentrations are measured at various locations throughout the RTNS-II facility (Bldg. 292). These are

| | |
|------------|------------------------------------|
| Monitor 1 | Target storage vault/hot cell vent |
| Monitor 2 | Tritium scrubber #2 |
| Monitor 3 | Tritium scrubber #1 |
| Monitor 4 | Tritium Scrubber Room (Rm. 1202) |
| Monitor 7 | Left Target Room (Rm. 1404) |
| Monitor 6 | Left Machine Room (Rm. 1402) |
| Monitor 8 | Main stack exhaust |
| Monitor 9 | Right Target Room (Rm. 1407) |
| Monitor 11 | Right Machine Room (Rm. 1406) |

Monitors 2, 3 and 8 are multi-range with auto-ranging capability. The ranges are 0-1 $\mu\text{Ci}/\text{m}^3$, 9-10 mCi/m^3 , 0-100 nCi/m^3 , and 0-20 Ci/m^3 . The others are single range units with a maximum reading of 20,000 $\mu\text{Ci}/\text{m}^3$.

II. SCHEMATIC DIAGRAMS

Schematic diagrams are given for the tritium monitoring units on the next pages. It should be noted that there are three different schematics depending on the tritium monitor unit. In practice, only unit 8 of units 1, 7, 8 and 9 has the DEOXO purifier section in operation. Typical flow meter readings are indicated on the schematic diagrams. More complete diagrams of the scrubber/tritium monitor system are posted at the tritium monitor location (Power Supply Room - Rm. 1204) and on tritium scrubber unit #1 in the scrubber Room (Rm. 1202).

Each unit has high and low level alarms (see Section F, Guide to Neutron Source Alarms).

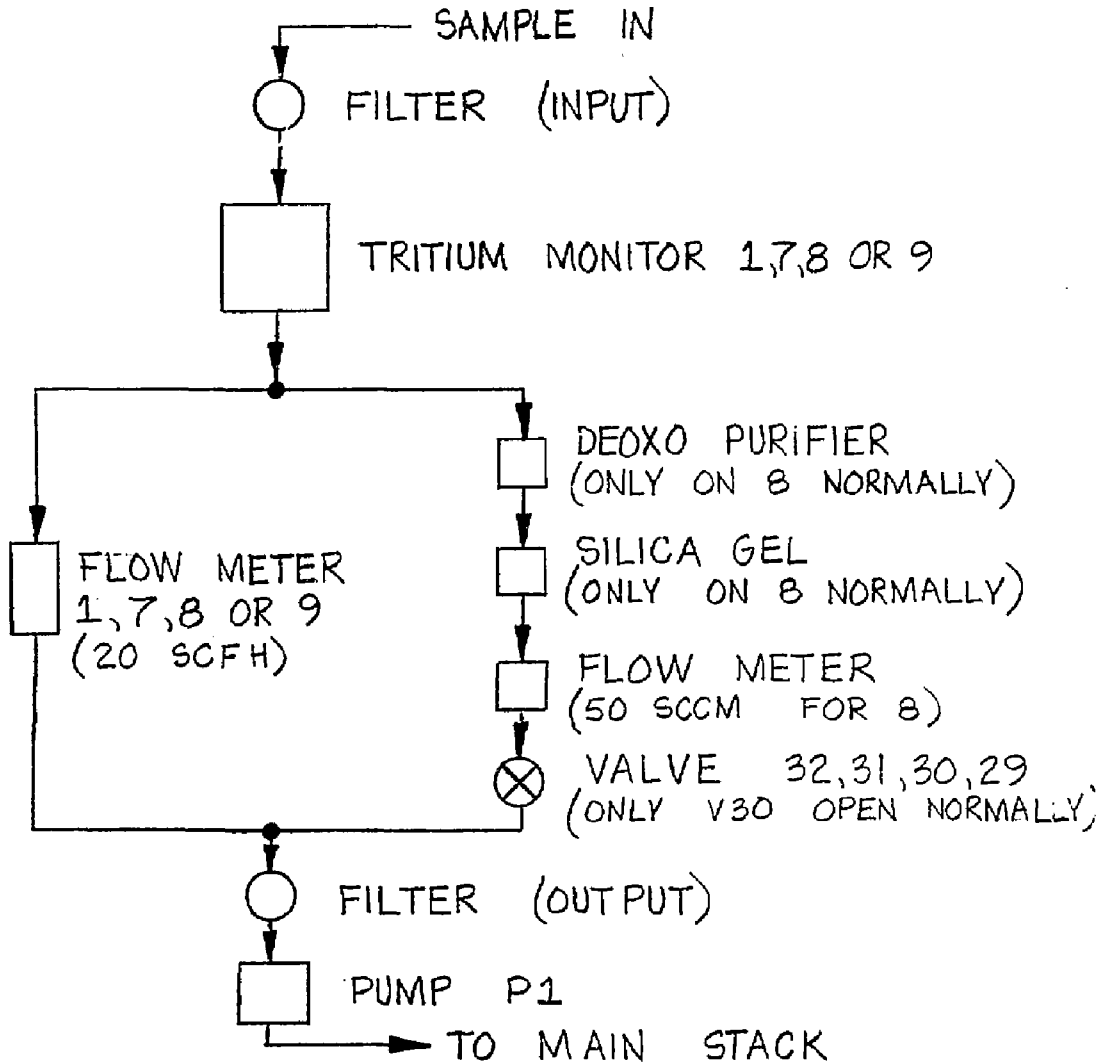
The normal settings for these alarms are (potentiometer setting).

| Monitor Number | LL | HL |
|----------------|------------------------------|------------------------------|
| 1 | 10 $\mu\text{Ci}/\text{m}^3$ | 50 $\mu\text{Ci}/\text{m}^3$ |
| 2 | | |
| 3 | | |
| 4 | 10 $\mu\text{Ci}/\text{m}^3$ | 50 $\mu\text{Ci}/\text{m}^3$ |
| 7* | 10 " | 500 " |
| 6 | 10 " | 50 " |
| 8 | 10 " | 50 " |
| 9* | 10 " | 500 " |
| 11 | 10 " | 50 " |

*Monitors 7 and 9 have the HL set higher to avoid continual alarming from ^{13}N activation in Target Room air during neutron source operation.

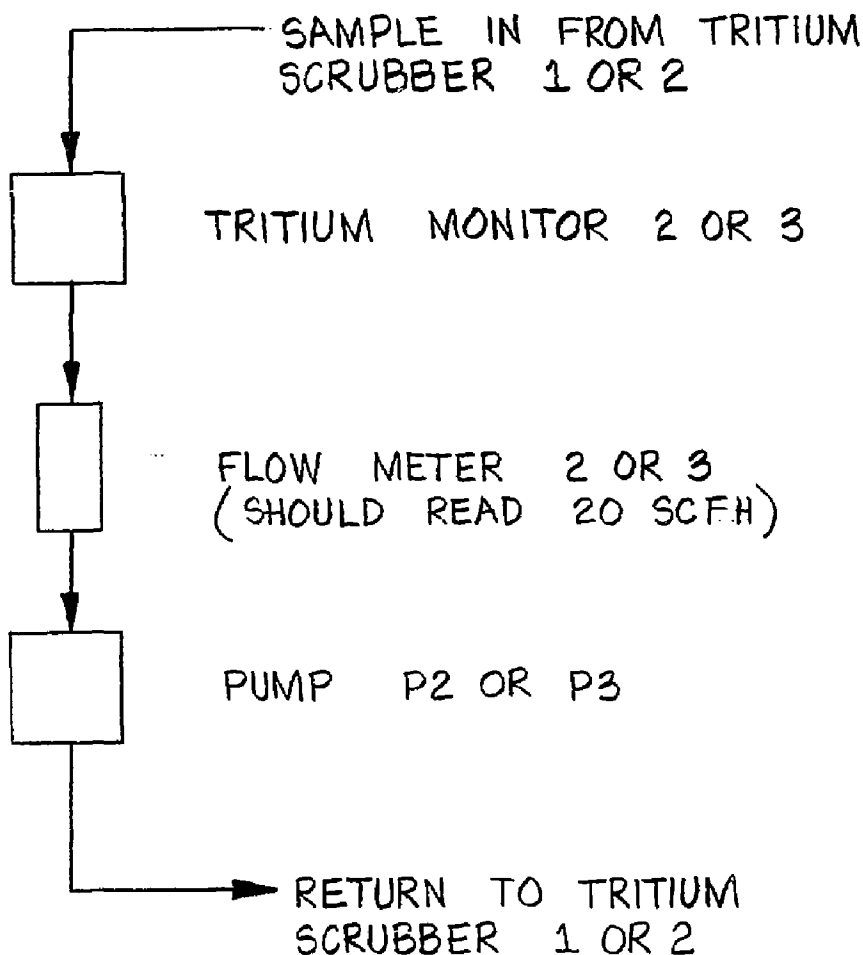
Tritium monitors 2 and 3 monitor scrubber performance and give an indication of beginning of breakthrough on the first molecular sieve (see Section J, Tritium Scrubber Maintenance).

SIMPLIFIED DIAGRAM
FOR TRITIUM MONITORS 1,7,8 & 9*



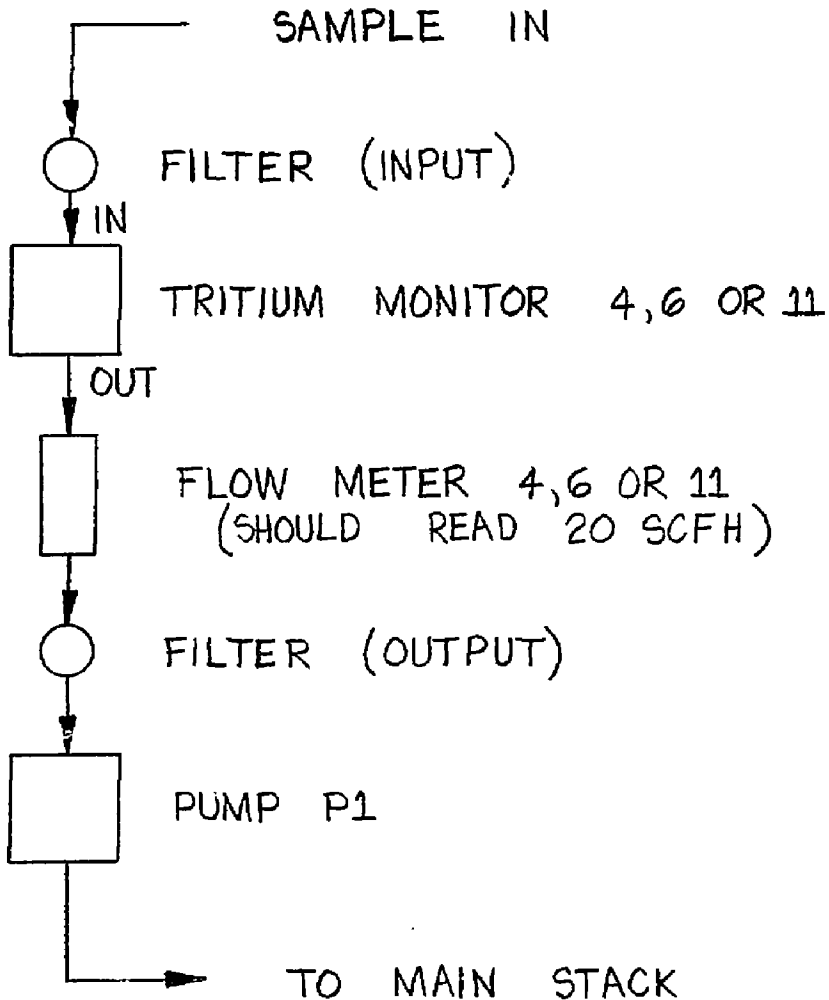
* ALL COMPONENTS EXCEPT INPUT FILTER ARE LOCATED AT SOUTH END OF POWER SUPPLY ROOM (RM 1204).

SIMPLIFIED DIAGRAM
FOR TRITIUM MONITORS 2 & 3*



* ALL COMPONENTS ARE LOCATED AT SOUTH END OF POWER SUPPLY ROOM (RM 1204).

SIMPLIFIED DIAGRAM FOR TRITIUM MONITORS 4,6 & 11*



* ALL COMPONENTS EXCEPT INPUT FILTER
ARE LOCATED AT SOUTH END OF POWER
SUPPLY ROOM (RM 1204).

Section 7
Summary of Normal Readings/Settings
February 22, 1985

I. INTRODUCTION

In this section we list the normal or nominal readings/settings for vacuum systems, water flow, etc. Where applicable, readings for both standby and normal operation (producing neutrons) are given. Some variation in readings is to be expected over long periods of time. Differences can also be expected between the two neutron sources, and depending on condition of the vacuum seal etc. However, the values given here should serve as useful guidelines.

We do not include readings/settings for such things as the ion source, accelerator or beam transport control parameters.

II. TERMINAL READINGS

A. Vacuum System

| | <u>Standby</u> | <u>Normal</u> |
|-----------|----------------------|----------------------|
| TC1 ~ TC4 | ~ 50 mtorr | ~ 50 mtorr |
| IG1 | ~ 4×10^{-7} | ~ 3×10^{-5} |
| IG2 | ~ 4×10^{-7} | ~ 4×10^{-6} |

B. Water Flow

| | <u>Standby</u> | <u>Normal</u> |
|--------|----------------|---------------|
| FS2-11 | All Off | All ON |
| FS12 | ON | ON |

C. Bleed Air

Bleed air should always be ~2SCFH (standard cubic feet/hour).

III. BEAM TRANSPORT/TARGET SYSTEM READINGS

A. Vacuum System

| | <u>Standby*</u> | <u>Normal*</u> |
|---------------------|----------------------|---------------------------|
| TC6-TC11 | ~ 50 mtorr | ~ 50 mtorr |
| TC26 (outer groove) | ~ 2.5 torr | ~ 3.5 torr |
| TC27 (inner groove) | ~ 80 mtorr | ~ 80 mtorr |
| IG3 | ~ 5×10^{-7} | ~ 2×10^{-6} |
| IG4 | ~ 5×10^{-6} | ~ 8×10^{-6} |
| IG5 | ~ 6×10^{-6} | ~ $.8-1.2 \times 10^{-5}$ |

*There may be variations between Left and Right neutron source

B. Water Flow

| | <u>Standby*</u> | <u>Normal*</u> |
|-------|-----------------|----------------|
| FS 12 | 0 | ~ 1.5 gpm |
| FS 13 | 0 | ~ 1.0 " |
| FS 14 | 0 | ~ 2.0 " |
| FS 15 | 0 | ~ 2.0 " |
| FS 16 | 0 | ~ 2.0 " |
| FS 17 | 0 | ~ 3.0 " |
| FS 18 | 0 | ~ 4.0 " |
| FS 19 | 0 | ~ 3.0 " |
| FS 20 | ON | ON |
| FS 21 | OFF | ON |

*There may be variations between Left and Right neutron source

III. TRITIUM SCRUBBER/MONITORS

A. Scrubber (normal readings)

| | |
|-------------------------|----------------------|
| Blower suction | 20" H ₂ O |
| Scrubber flow | 2500 SCCM |
| Scrubber input pressure | ~ -(15-20) units |
| Converter temperature | 400°C |

B. Tritium Monitors

Flows for all units should be adjusted to 20 SCFH using the flow controls. In addition, for tritium monitor 8 the flow meter in the silica gel leg should be set at 50 cc/min.

C. Stack Flow Reading

The stack flow is nominally 11 m³/s. This reading may vary somewhat, depending on whether the scrubber hood doors or the Hot Work Room doors are open. The stack area is .4 m² and therefore stack volumetric flow is 4.4 m³/s.

D. Miscellaneous Readings

| | |
|------------------------------------|--------------|
| Isolation transformer temperature | ~60°C |
| Isolation transformer current | 70-80A/phase |
| Haefely high voltage PS efficiency | ~75% |
| Oil mister input pressure | ~10 psi |
| Oil mister oil level | ~ 3 gal. |
| Oil mister output pressure | ~ 2 psi |

Section N
Additional Documentation
February 22, 1985