U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: PRELIMINARY VENTILATION ANALYSIS

PRESENTER: ROMEO S. JURANI

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SEPTEMBER 18 - 19, 1991

OBJECTIVES AND REQUIREMENTS

ESFDR 1.2.6.3.1/FR.1

- PROVIDE A VENTILATION SYSTEM TO SUPPLY VENTILATION AIR TO AND EXHAUST VENTILATION FROM THE SUBSURFACE WORKINGS TO MEET THE NEEDS OF CONSTRUCTION AND OPERATION OF THE UNDERGROUND SITE CHARACTERIZATION AND TESTING PROGRAM

ESFDR 1.2.6.3.1/PC.1a

- THE VENTILATION SYSTEM SHALL SUPPLY AND EXHAUST ADEQUATE QUANTITIES OF AIR TO AND FROM UNDERGROUND WORKING AREAS SUCH THAT OPERATOR'S SAFETY, HEALTH AND PRODUCTIVITY REQUIREMENTS ARE MAINTAINED

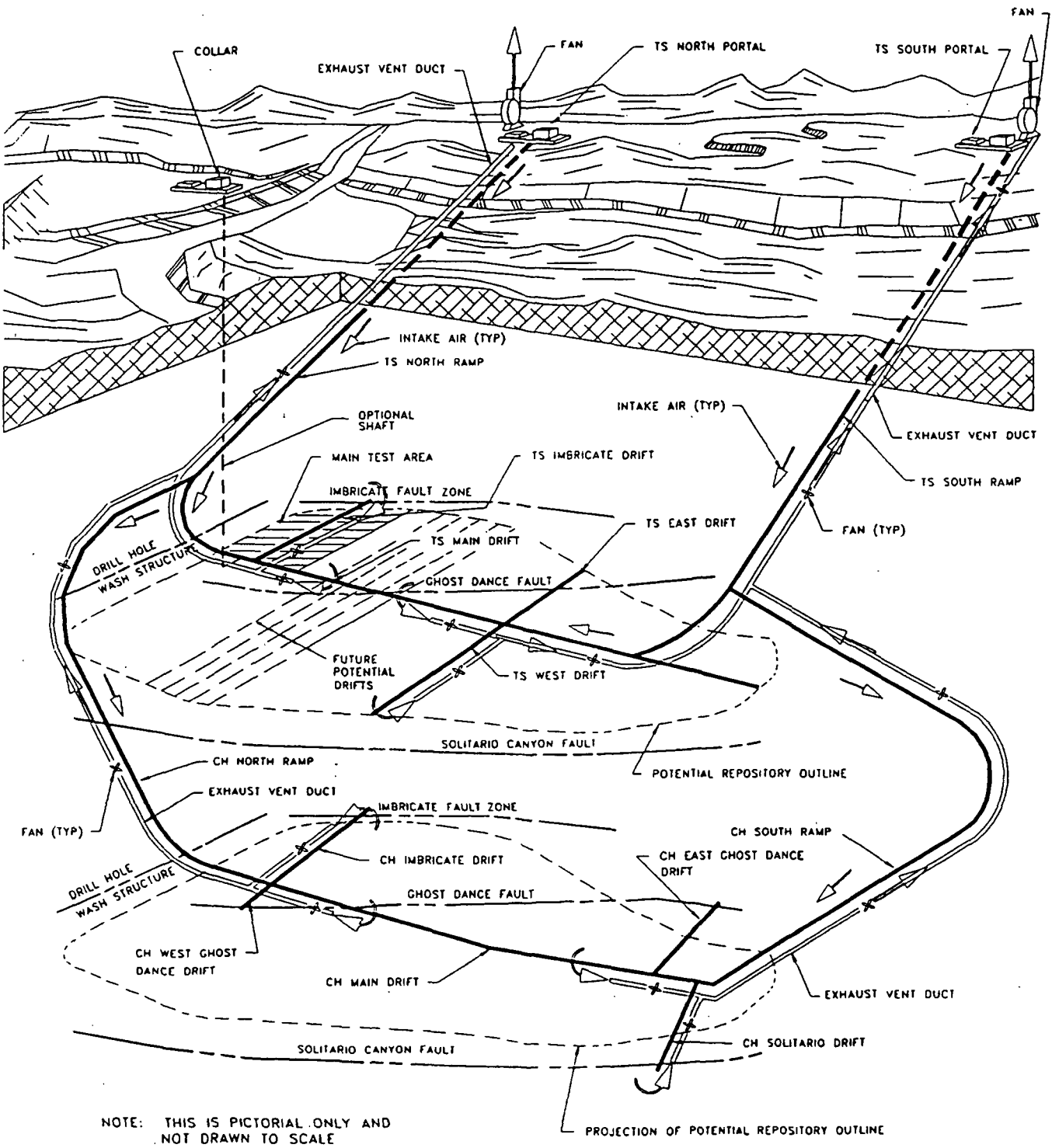
GIVEN FEATURES

DEVELOPMENT AND CHARACTERIZATION SEQUENCE

- CONSTRUCTIONS PHASE
  - INITIALLY TWO RAMP HEADINGS
    TS SOUTH AND TS NORTH
  - SUBSEQUENTLY EIGHT DEVELOPMENT HEADINGS
    SOUTH RAMP DEVELOPMENT SYSTEM - FOUR
    TS SOUTH AND ONE TS LATERAL
    CH SOUTH AND ONE CH LATERAL

    NORTH RAMP DEVELOPMENT SYSTEM - FOUR
    TS NORTH AND ONE TS LATERAL
    CH NORTH AND ONE TS LATERAL
  - CONNECTION OF TS OR CH LEVEL FOR FLOW-THROUGH VENTILATION TO SUPPORT ESF MULTIPLE ACTIVITIES

VENTILATION NEAR CONNECTION OF TS OR CH LEVEL



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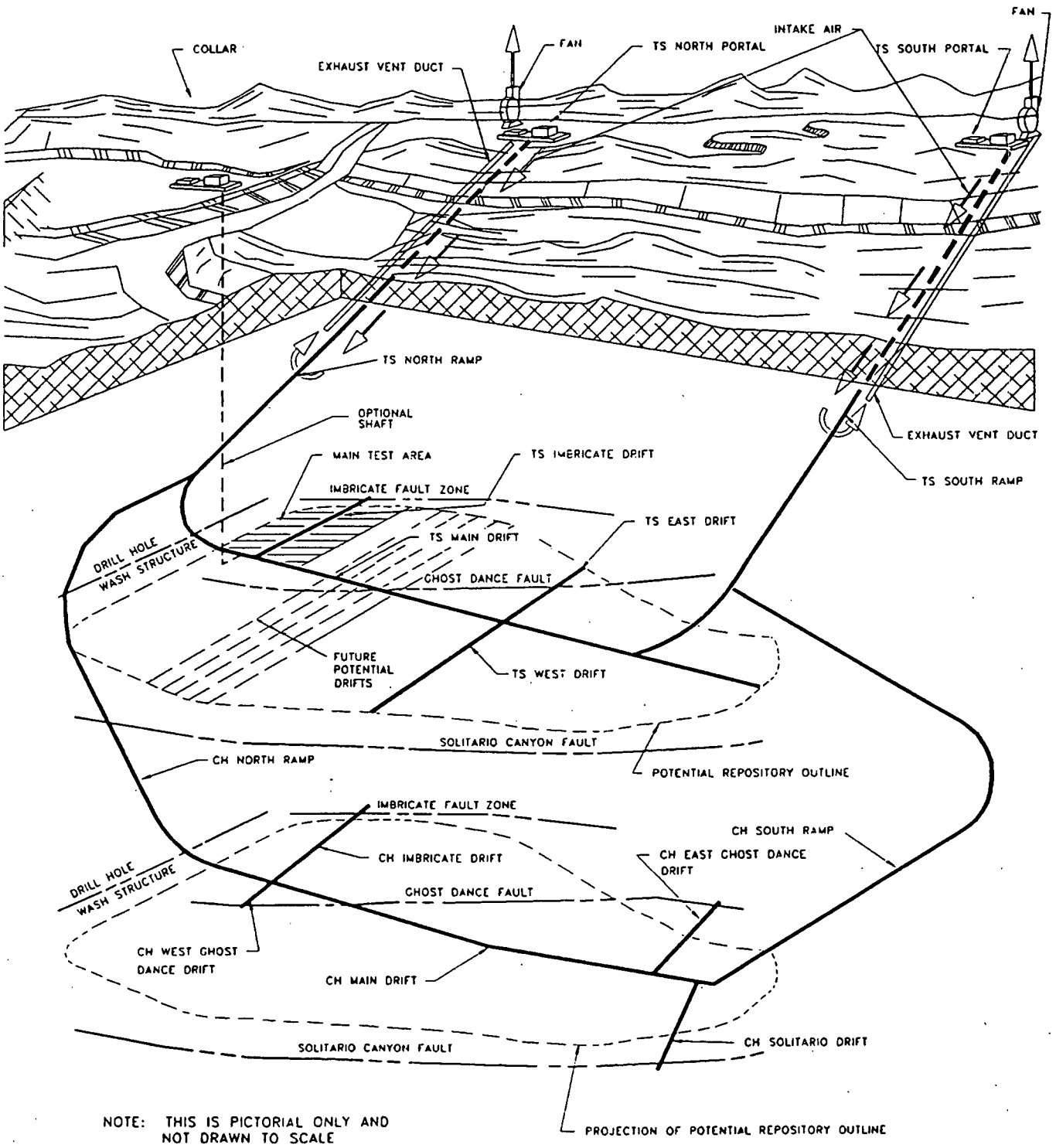
EARLY CONSTRUCTION VENTILATION



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ESF AIRFLOW VELOCITY REQUIREMENT

- **SURVEY OF MINING INDUSTRY PRACTICES**
  - FACE AIR VELOCITY RANGES

    100 - 150 FPM

- **VENTILATION EXPERT RECOMMENDATION**
  - FACE AIR VELOCITY RANGES

    100 - 400 FPM

- **RECOMMENDATION FOR ESF FACE AIR VELOCITY RANGE**
  - 140 - 150 FPM

    (ABOVE CALIFORNIA AND MSHA CODE MINIMUM REQUIREMENT)

- **ALLOW 15% LEAKAGE FACTOR**
  - RECOMMENDED EQUIVALENT ESF DESIGN VELOCITY RANGE

    165 - 176 FPM

AIRFLOW CONSTRUCTION REQUIREMENT - 188,500 CFM

SOUTH OR NORTH RAMP DEVELOPMENT SYSTEM

- TS RAMP OR TS MAIN DRIFT (25' DIA) - 82,000 CFM
  - (167 FPM x 491 FT^2)
- TS LATERAL - ONE FACE (20' x 12') - 40,000
  - (167 FPM x 240 FT^2)

  TS TOTAL - 122,000 CFM
- CH RAMP OR CH MAIN DRIFT (18' DIA) - 42,500
  - (167 FPM x 254 FT^2)
- CH LATERAL - ONE FACE (16' x 9') - 24,000
  - (167 FPM x 144 FT^2)

CH TOTAL - 66,500 CFM

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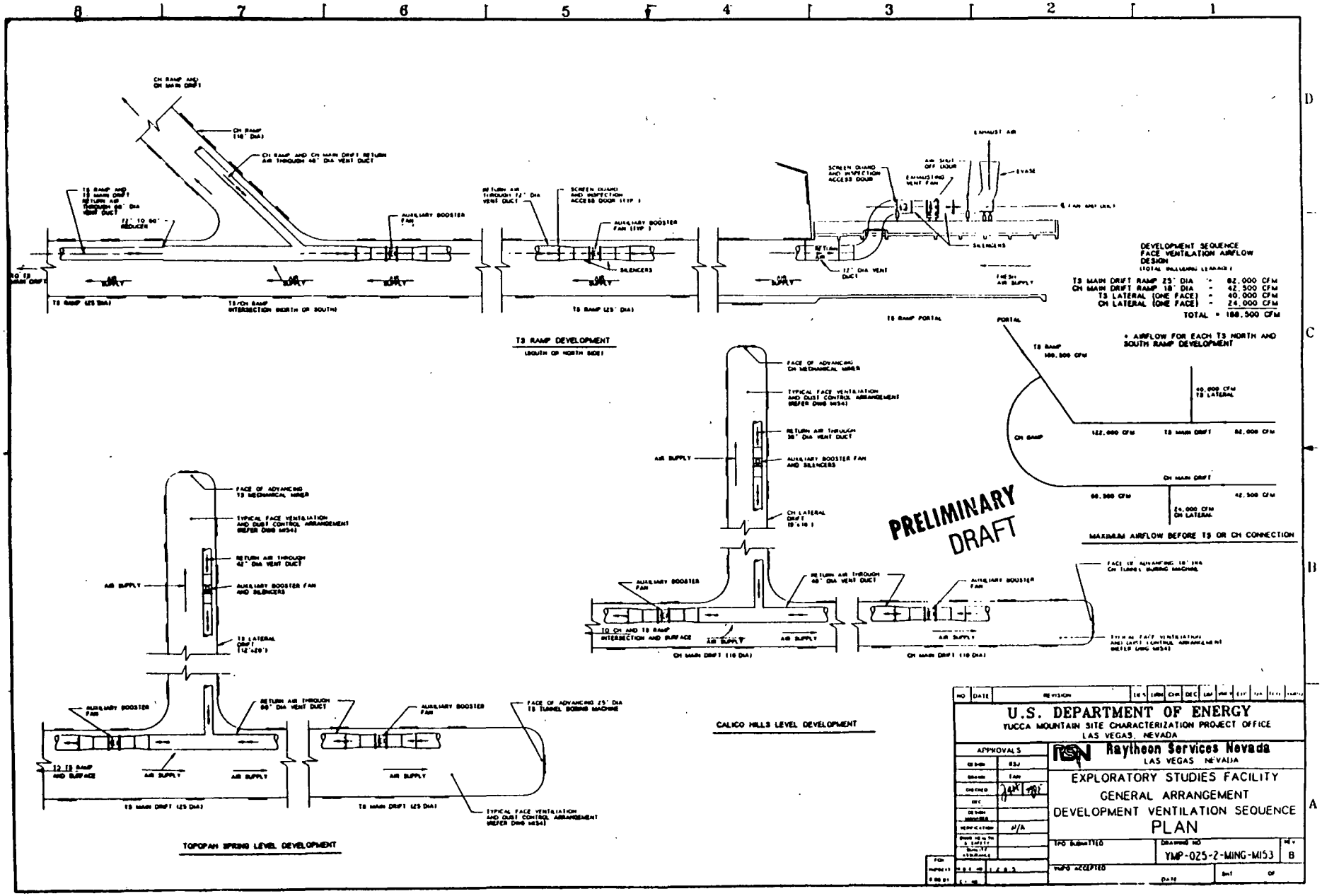
DEVELOPMENT VENTILATION SEQUENCE



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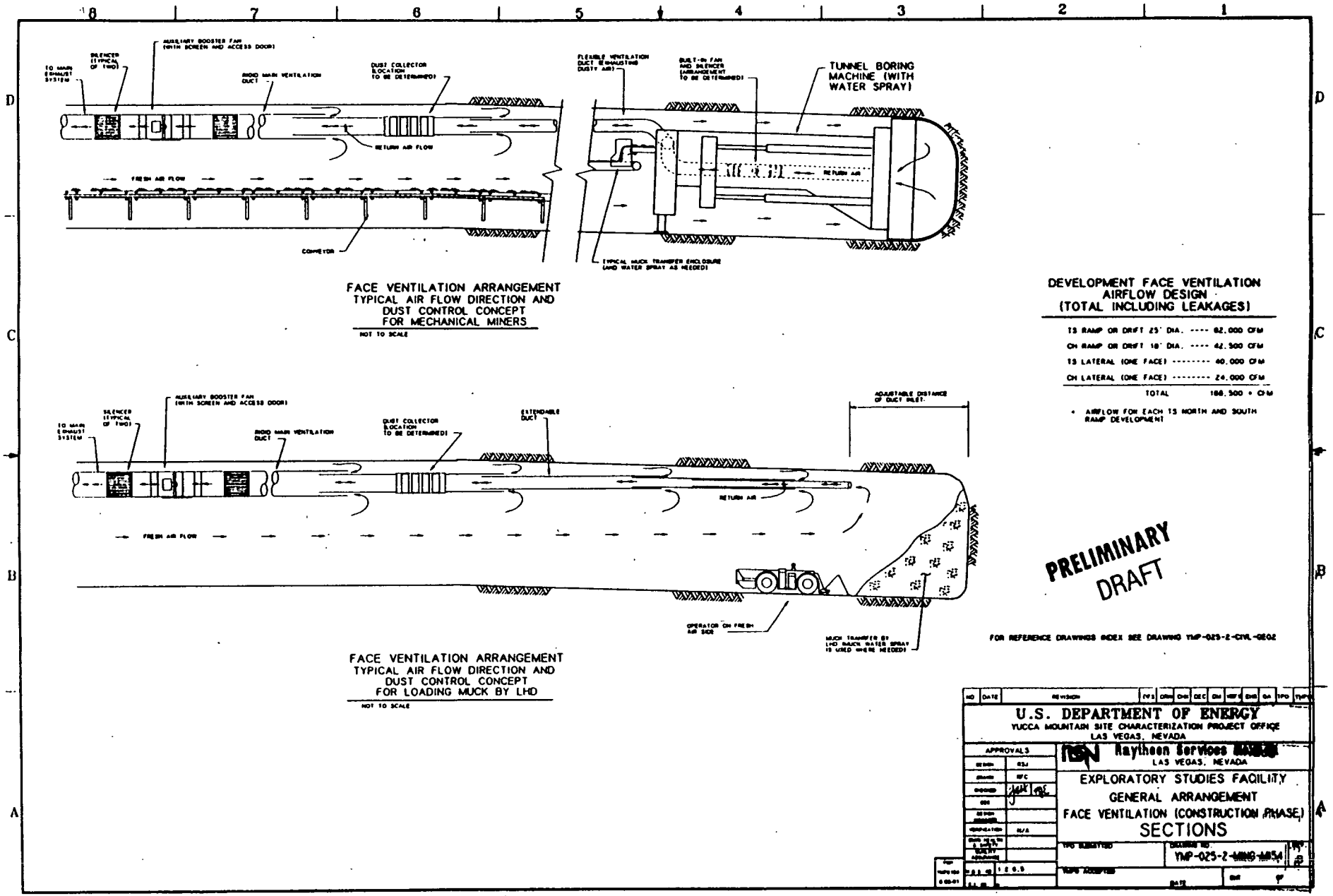
FACE VENTILATION (CONSTRUCTION PHASE)



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CONSTRUCTION BHP REQUIREMENT

BEFORE CONNECTION OF TS AND CH MAIN LEVEL DRIFTS

- CURRENT VENT DUCT DIAMETER USED (72" MAIN)
  - NORTH RAMP SYSTEM (60% MOTOR EFF) 7,040 BHP
  - SOUTH RAMP SYSTEM (60% MOTOR EFF) 8,830
    TOTAL 15,870 BHP

- CURRENT VENT DUCT DIAMETER INCREASED BY 12" (84" MAIN)
  - NORTH RAMP SYSTEM (60% MOTOR EFF) 3,200 BHP
  - SOUTH RAMP SYSTEM (60% MOTOR EFF) 3,980
    TOTAL 7,180 BHP

AIRFLOW OPERATION REQUIREMENT - 400,000 CFM

- TS IMBRICATE DRIFT (20' x 12') - 40,000 CFM
  (167 FPM x 240 FT^2)
- TS WEST DRIFT - (20' x 12') - 40,000
- TS EAST DRIFT - (20' x 12') - 40,000
- TS MAIN TEST AREA (PACKAGE) - 130,000
- TS MECHANICS SHOP (PACKAGE) - 35,000

TS LEVEL TOTAL - 285,000 CFM

AIRFLOW OPERATION REQUIREMENT - 400,000 CFM

(CONTINUED)

- CH IMBRICATE DRIFT (16' x 9') - 25,000 CFM
  (174 FPM x 144 FT^2)
- CH WEST GHOST DANCE (16' x 9') - 25,000
- CH EAST GHOST DANCE (16' x 9') - 25,000
- CH SOLITARIO DRIFT (16' x 9') - 25,000
- CH MECHANICS SHOP (PACKAGE) - 15,000

CH LEVEL TOTAL - 115,000 CFM

ESTABLISHING FRESH AND RETURN AIRWAYS

- TS NORTH RAMP STRATEGIC LOCATION AS INTAKE AIRWAY
  - NEAR BUILDINGS, AND NEAR SUPPORT FACILITIES
  - MORE TESTING AT TS NORTH RAMP
  - REPOSITORY INTERFACE INTAKE AIRWAY
- TS SOUTH RAMP AS EXHAUST AIRWAY
  - CONVEYOR HAULAGE CONCENTRATION

RECOMMENDATION: TS NORTH RAMP - INTAKE
TS SOUTH RAMP - EXHAUST

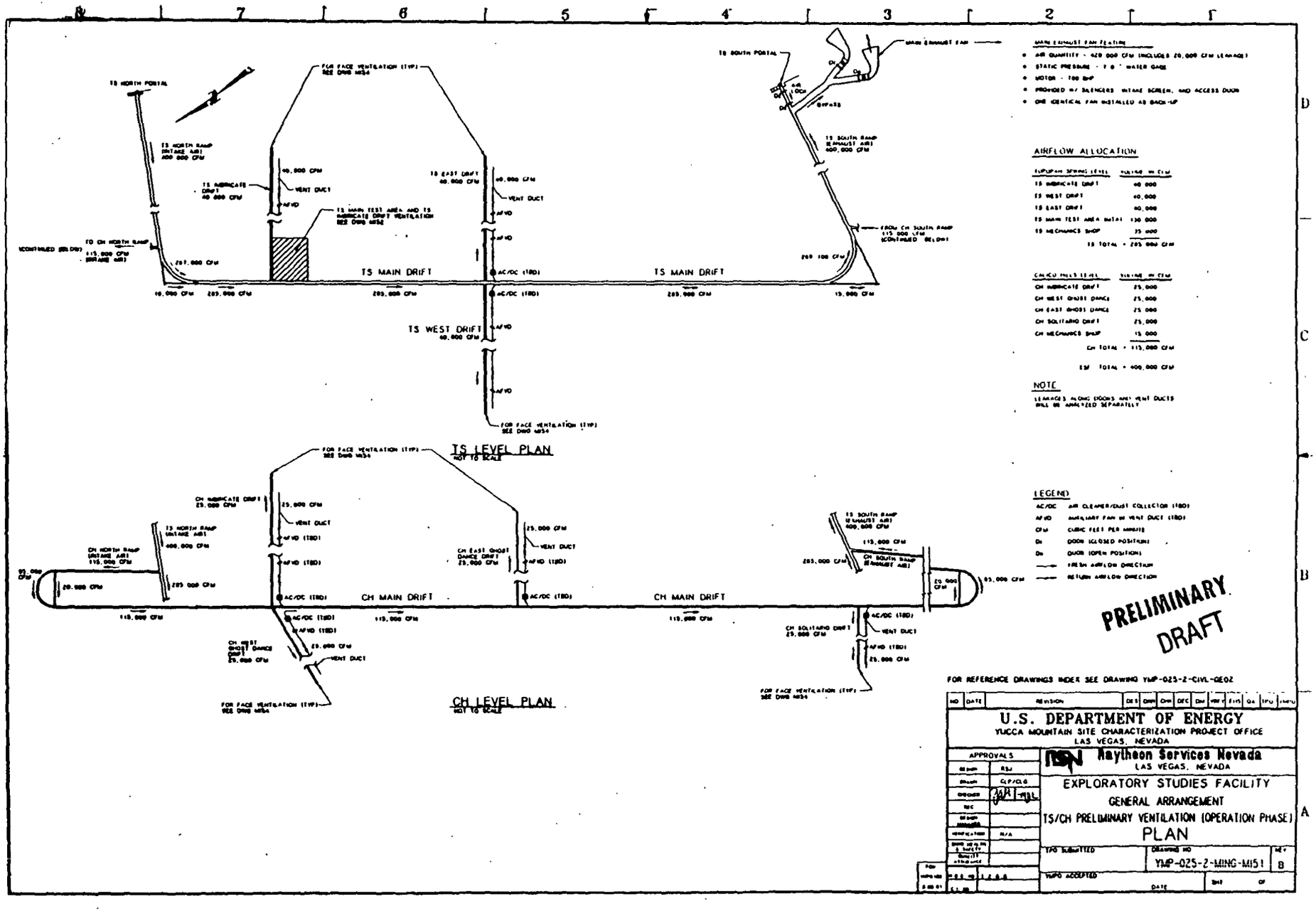
LOCATION OF PRIMARY SURFACE FAN

FAVORABLE FEATURES - FAN LOCATION ON SOUTH PORTAL (EXHAUSTING MODE)

- LESS SUPPORT FACILITIES
- LESS IMPACTIVE FAN NOISE AND EXHAUST AIR
- LESS TRAFFIC - LESS AIRLOCK DISTURBANCE
- EXHAUST FAN ADVANTAGE - VERTICAL DISCHARGE
- FACILITATES INITIAL REPOSITORY CONSTRUCTION

RECOMMENDATION: FAN LOCATION ON SOUTH PORTAL (EXHAUSTING MODE)

TS/CH PRELIMINARY VENTILATION (OPERATIONS PHASE)



MAIN EXHAUST FAN FEATURE

- AIR QUANTITY - 420 000 CFM (INCLUDES 20,000 CFM LEAKAGE)
- STATIC PRESSURE - 7.0" WATER GAGE
- MOTOR - 700 BHP
- PROVIDED W/ SILENCERS INTAKE SCREEN, AND ACCESS DOOR
- ONE IDENTICAL FAN INSTALLED AS BACK-UP

AIRFLOW ALLOCATION

FUPUPAH SPRING LEVEL	VOLUME IN CFM
TS FABRICATE DRIFT	40 000
TS WEST DRIFT	40,000
TS EAST DRIFT	40,000
TS MAIN TEST AREA (MTA)	130 000
TS MECHANICS SHOP	35 000
TS TOTAL =	285 000 CFM

CH/CU HILLS LEVEL	VOLUME IN CFM
CH FABRICATE DRIFT	25,000
CH WEST GHOST DANCE	25,000
CH EAST GHOST DANCE	25 000
CH SOLITARIO DRIFT	25,000
CH MECHANICS SHOP	15 000
CH TOTAL =	115,000 CFM
ESF TOTAL =	400,000 CFM

NOTE

LEAKAGES ALONG DOORS AND VENT DUCTS WILL BE ANALYZED SEPARATELY

LEGEND

- AC/DC AIR CLEANER/DUST COLLECTOR (TBD)
- AFVD AUXILIARY FAN W/ VENT DUCT (TBD)
- CFM CUBIC FEET PER MINUTE
- Dc DOOR (CLOSED POSITION)
- Do DOOR (OPEN POSITION)
- FRESH AIRFLOW DIRECTION
- RETURN AIRFLOW DIRECTION

PRELIMINARY DRAFT

FOR REFERENCE DRAWINGS INDEX SEE DRAWING YMP-025-2-CIVL-GE02

NO	DATE	REVISION	DES	DRN	CHK	DEC	DM	VER	FIS	QA	IPU	INFU

U.S. DEPARTMENT OF ENERGY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE
LAS VEGAS, NEVADA

Raytheon Services Nevada
LAS VEGAS, NEVADA

APPROVALS

DESIGN	RSJ
DRAWN	CLP/CLG
CHECKED	
REC	
DESIGN MANAGER	
VERIFICATION	N/A
DWG REVIEW & SAFETY	
QUALITY ASSURANCE	

EXPLORATORY STUDIES FACILITY
GENERAL ARRANGEMENT
TS/CH PRELIMINARY VENTILATION (OPERATION PHASE)
PLAN

TPO SUBMITTED
DRAWING NO YMP-025-2-MING-MI51 REV B
TPO ACCEPTED
DATE
SHT OF

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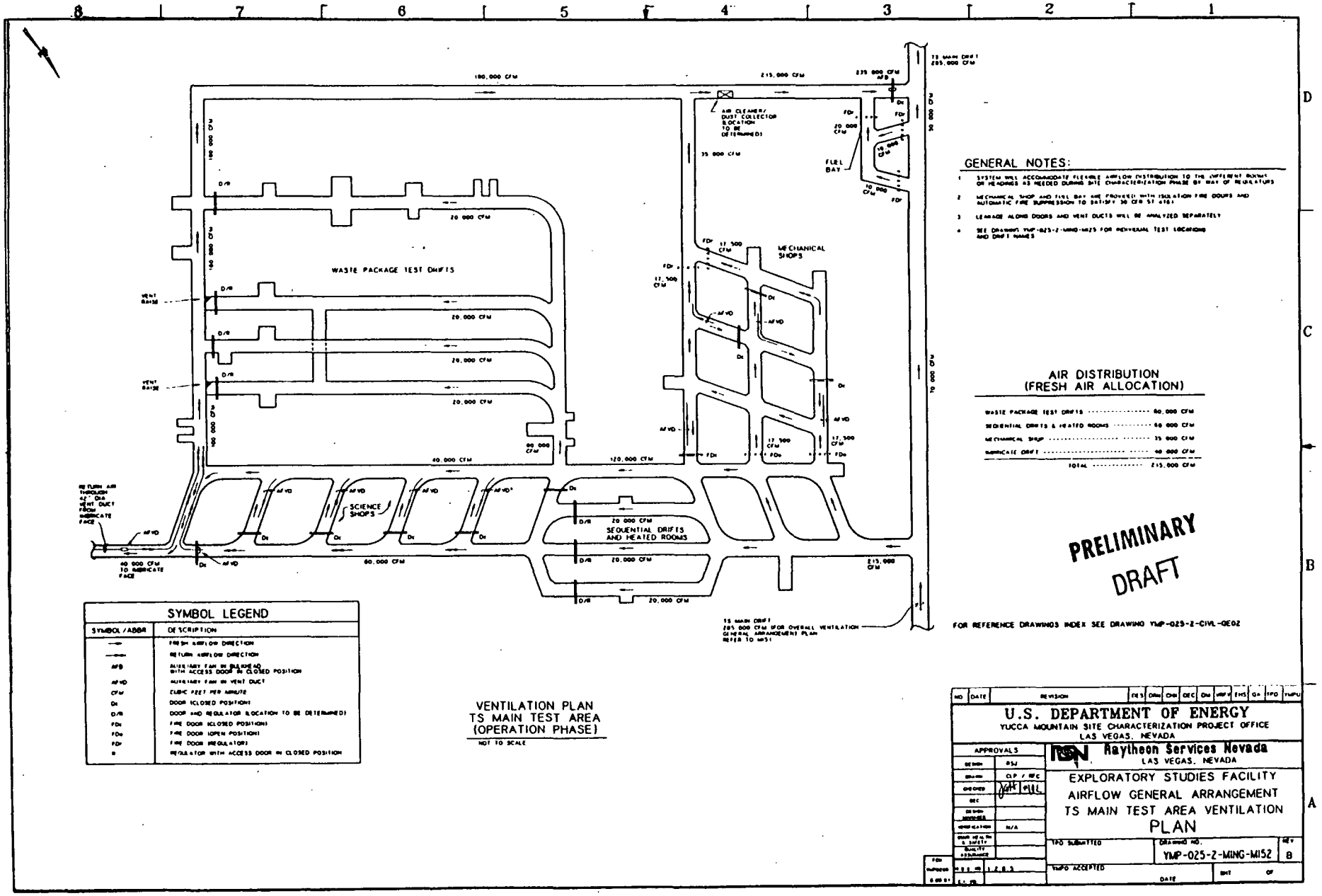
TS MAIN TEST AREA VENTILATION



COMPUTER MODEL - OPERATION PHASE

- FLOW-THROUGH VENTILATION - 400,000 CFM
- PRIMARY SURFACE FAN FEATURE AND ESTIMATED PERFORMANCE
  - FAN MOTOR REQUIREMENT - 700 BHP
  - FAN OUTPUT - 420,000 CFM
    (INCLUDES 20,000 CFM PORTAL LEAKAGES)
  - STATIC PRESSURE - 7.0 INCHES WATER GAGE
  - ONE IDENTICAL FAN INSTALLED AS BACKUP

AIR COOLING?

AIR TEMPERATURE UNDERGROUND

- **MAINTAIN BELOW 82°F (WET BULB)**
  - (EQUIVALENT TO 260 W/M^2 AIR COOLING POWER)
- **MINING INDUSTRY EXPERIENCE**
  - MECHANICAL COOLING NEEDED WHEN VIRGIN ROCK TEMPERATURE IS >105°F
  - ESF VIRGIN ROCK TEMPERATURE 75° - 78°F
- **PRELIMINARY CONCLUSION:**
  - NO MECHANICAL COOLING NEEDED

HEATING OF INTAKE AIR?

- HEATING OF INTAKE AIR DURING WINTER
  - PREVENTS ICING OF THE NORTH PORTAL AND FEW FEET INSIDE
  - MINIMIZES POTENTIAL SICKNESS OF PERSONNEL GOING THROUGH COLD AIR
- MINING INDUSTRY GENERAL PRACTICE (SAME RAMP SITUATION)
  - NO HEATING
  - PERSONNEL WEAR WINTER CLOTHING
  - CHIP ICE MANUALLY WHEN NEEDED
- PENDING STUDY: ESTABLISH THE ESF WINTER INTAKE AIR HAZARDS
- IF HEATING IS JUSTIFIED:
  - REQUIRES 5300 KW TO HEAT 400,000 CFM FROM 5°F TO 42°F

STATIONARY AND MOBILE DUST COLLECTION UNITS

FOR MOBILE UNITS - FEATURE TO GO WITH MINING ACTIVITY

- TBM OPERATION
- DRILLING
- BOLTING
- AFTER BLASTING
- MUCKING

- MINE-PROVEN, COMMERCIALLY AVAILABLE
- MSHA TESTED (RI 1150, 1984)
- FIVE STAGE DUST REMOVAL AND DISPOSAL
- COLLECTION EFFICIENCY
  - 99% PARTICLES >3.0 MICRONS
  - 96% PARTICLES DOWN TO 1.0 MICRONS (TESTED 0.79U)
  - AIR QUANTITY PROCESSED - 10,000 TO 15,000 CFM

OTHER STUDIES TO BE CONDUCTED

- VENTILATION LIFE SAFETY AND MONITOR
  - EVACUATION AND EMERGENCY VENTILATION (VARIOUS CASES)
  - MONITORING OF GASES AND PARTICULATES
- UNDERGROUND ENVIRONMENTAL CLIMATE
  - PREDICTION OF UNDERGROUND TEMPERATURES (GIVEN HEAT LOADS OF EQUIPMENT AND TESTING ACTIVITIES)
- DUST CONTROL STRATEGY
- FAN NOISE

WHEN ARE STUDIES NEEDED?

- MOST STUDIES APPLY TO ALL PHASES OF ESF CONSTRUCTION AND OPERATION
- STUDIES ARE TO BE CONDUCTED BEFORE AND CONCURRENT WITH TITLE II ACTIVITIES AS DATA BECOMES AVAILABLE