THE INSTALLATION OF UNDERGROUND BOOSTER FANS AT NORTH GOONYELLA COAL MINE

VENTILATION SYSTEM PRIOR TO BOOSTER FANS

System requirements are;-

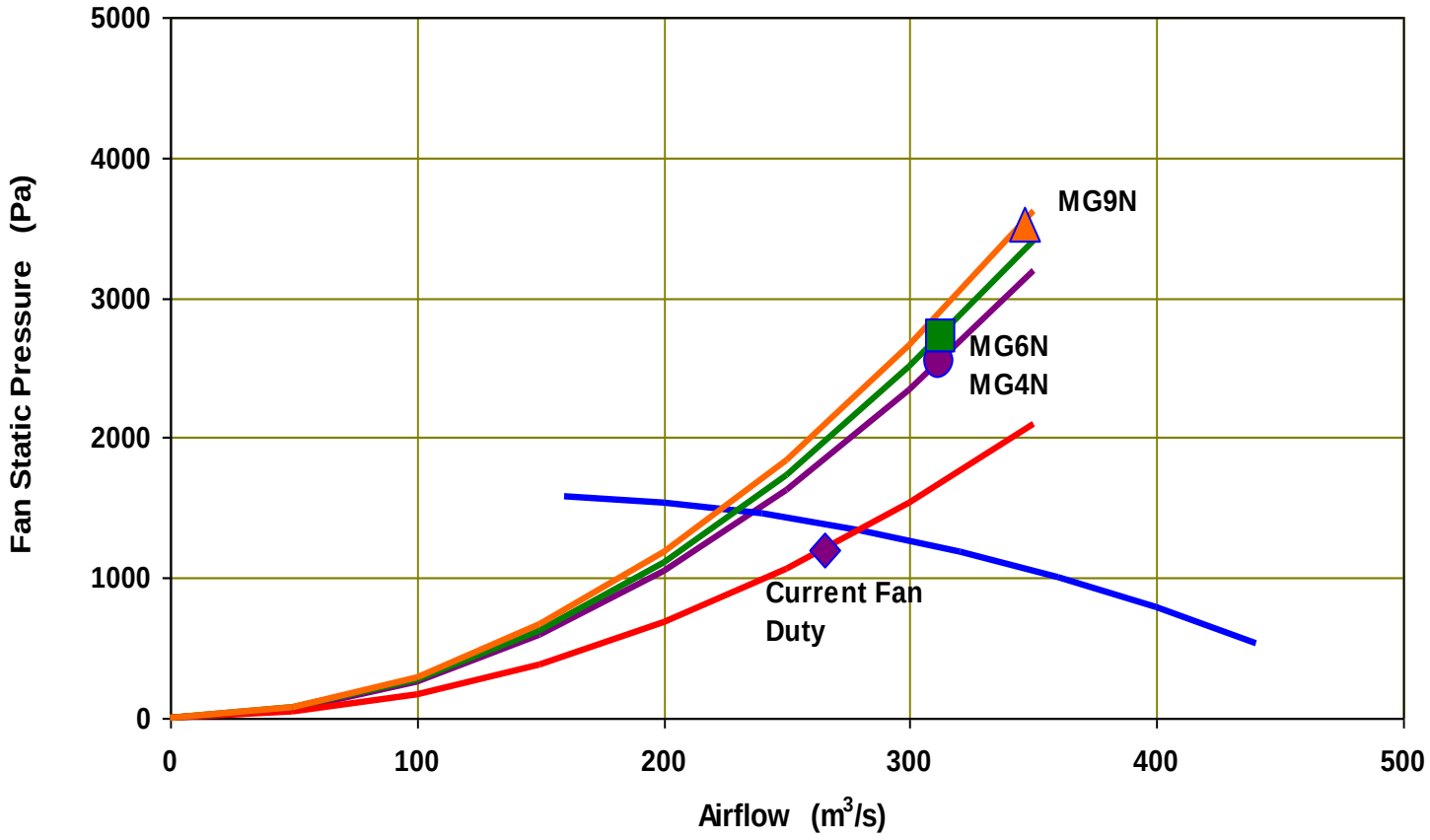
Maintain intake Methane GB concentration below 0.5%;
Virgin gas content increasing with depth;
Expected development advance rates increasing to 180 m/wk;
Require 70 m^3/s at last open c/t in MG development.

Ventilation Planning indicated that the current system would be unable to meet system requirements beyond 2400 chainage in MG4N.

Main fans operating near design capacity.

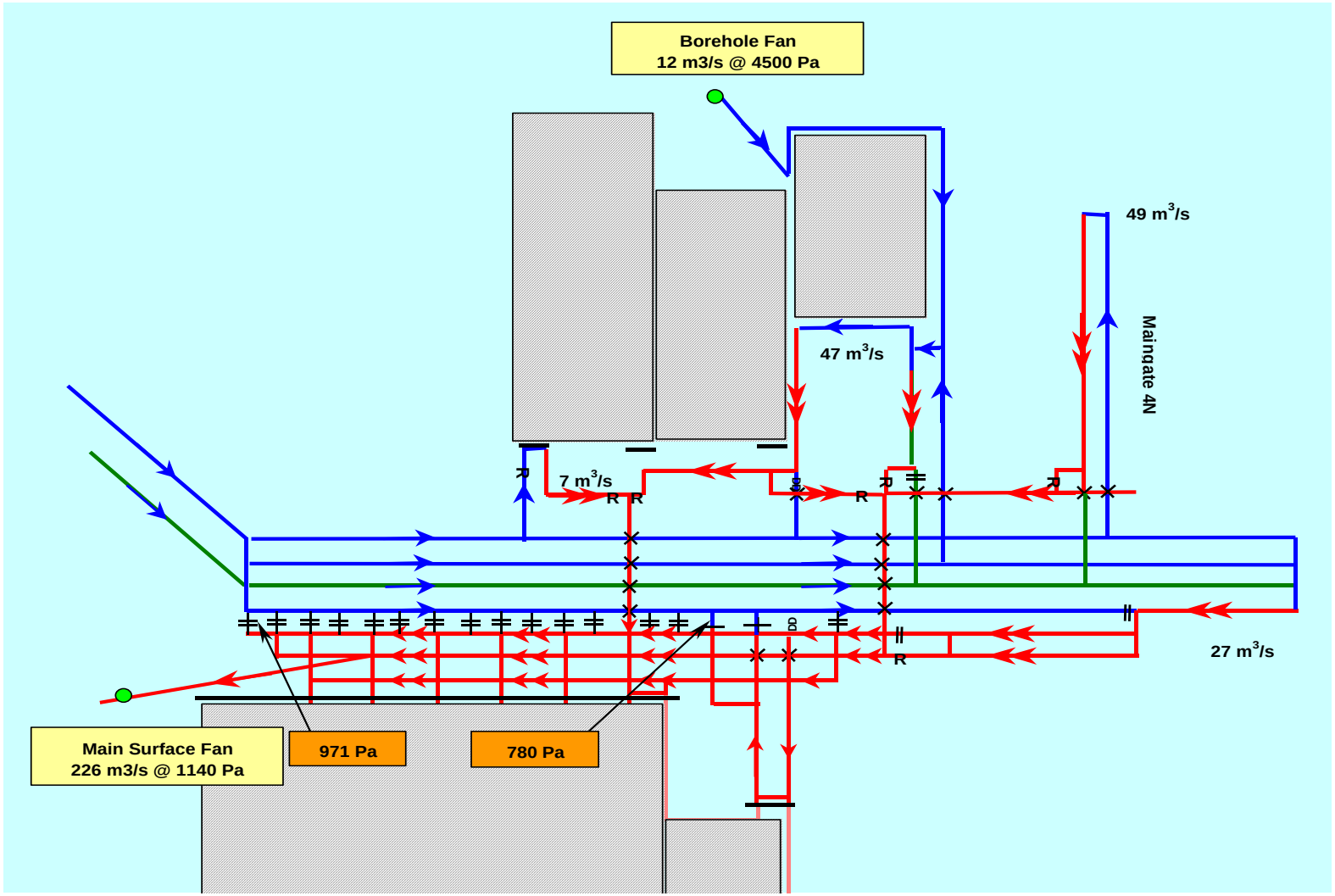
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

MAIN FAN PERFORMANCE PRIOR TO BOOSTER FANS



INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

VENTILATION PRIOR TO BOOSTER FANS



BOOSTER FAN INSTALLATION

- Twin fan installation located in the main return airways at G & I headings 25 c/t.
- Each fan is powered by a single 600 kW motor located in a purpose designed intake air chamber
- Centrifugal fan
- Variable speed control
- Designed to service the mine to LW9N
- Central bypass airway to maintain mine ventilation when the booster fan is non operational.

BOOSTER FAN INSTALLATION

Preferred option because;-

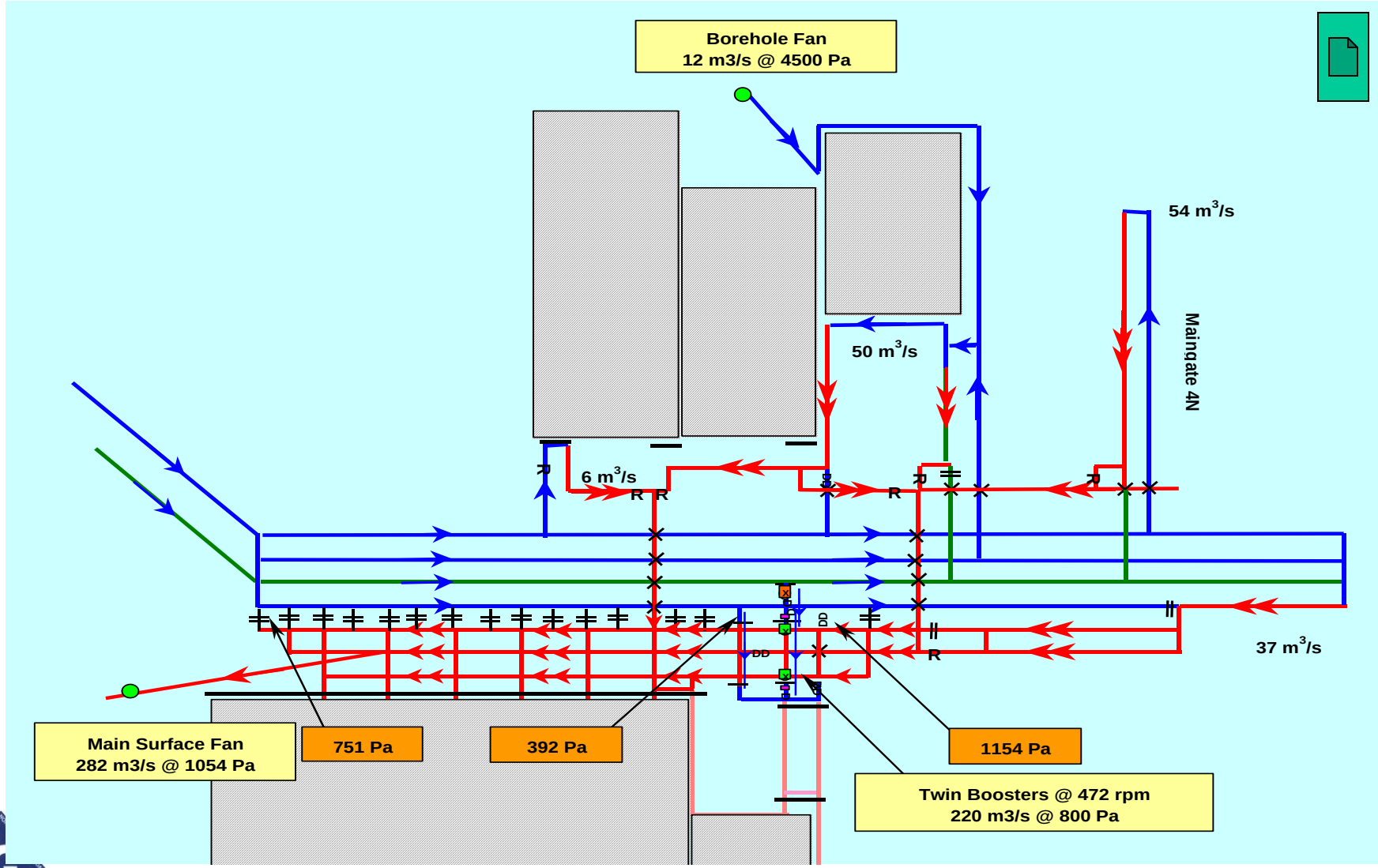
Underground pressure differentials

Cost

Timing

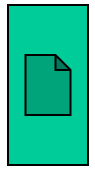
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

Ventilation After Booster Fan Installation



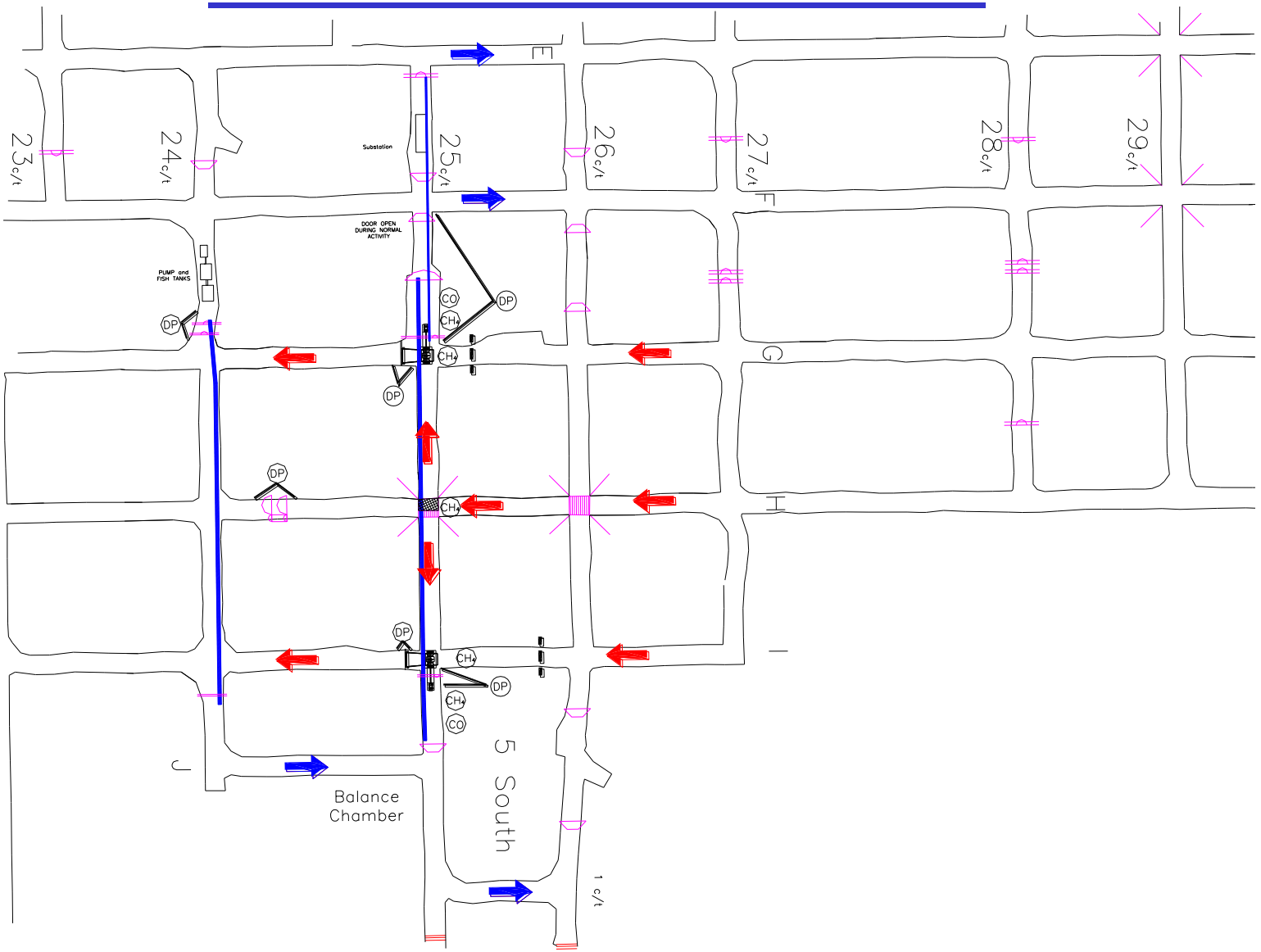
BOOSTER FAN INSTALLATION

- Place fan in series with existing main fans
- Apply additional air power to inbye workings
- Reduced ventilation pressures outbye of the booster
- Increased ventilation pressures inbye of the booster
- Reduction of main fan requirements for a given inbye performance



INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

BOOSTER FAN INSTALLATION

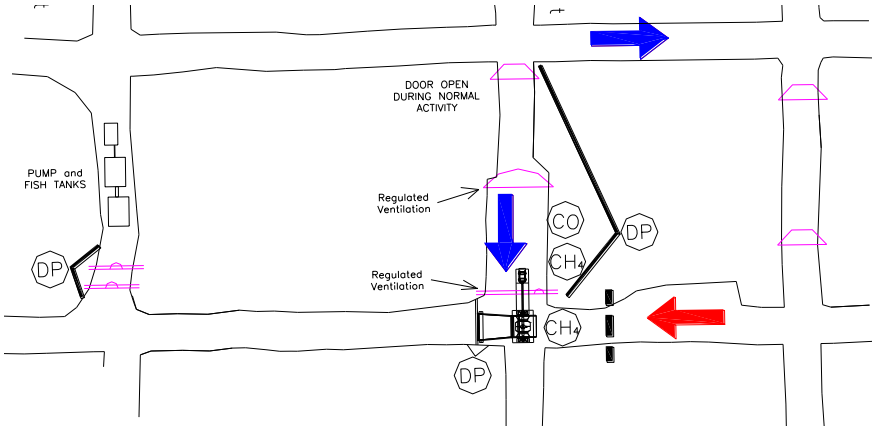


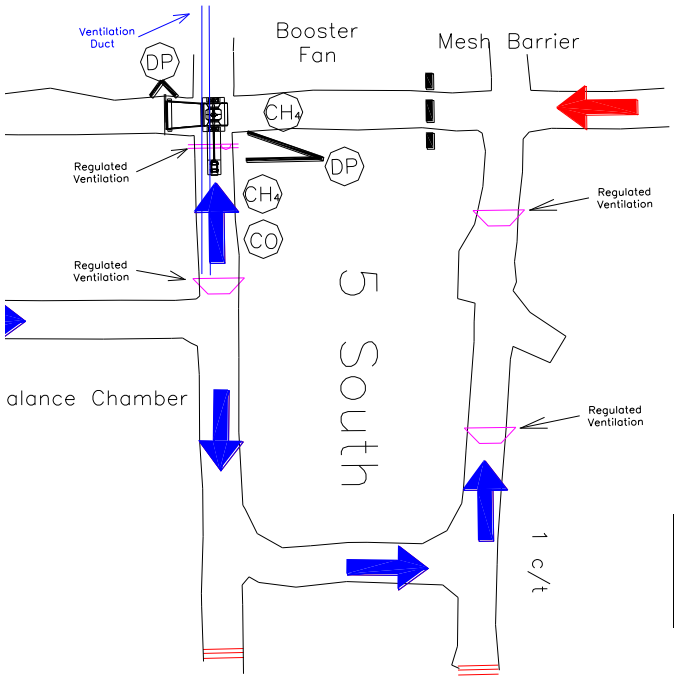
North Goonyella Coal Mine

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

MONITORING

- Ventilation Pressure
  - Booster fans
  - Motor bulkheads
  - Bypass doors
- Methane
  - Motor chambers
  - Booster fan inlet
- Carbon Monoxide
  - Motor chambers
- Fan Speed
- Motor bearing – vibration & temperature
- Fan shaft bearing – vibration & temperature





INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

INSPECTIONS

Frequency	Responsibility	Inspection
Twice / shift	ERZ Controller	Motors & Substation
Shiftly	ERZ Controller	Booster Fans
Monthly	Ventilation Officer	Ventilation Adequacy VCD Integrity Accelerated Oxidation

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

NORMAL OPERATING CONDITIONS

- Under normal operating conditions the mine is ventilated by:
  - Twins surface fans.
  - Both booster fans running.
  - Maingate borehole forcing fan.
- The central bypass doors are closed when the booster fans are running.

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

NORMAL OPERATING CONDITIONS

- To alter the duty of either the main surface fans, the booster fans or the borehole fan is classified as a Major Ventilation Change and as such requires authorisation from the Ventilation Officer & countersigned by the Mine Manager.

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

CHANGING SETTINGS

- Ventilation Change Scope of Work prepared and authorised by the Ventilation Officer, countersigned by the Mine Manger. Based on ventilation modeling of the change defining:
  - Target face ventilation quantities.
  - Main fan duty
  - Intermediate and final booster fan speed / duty settings
  - Goaf pressure balance arrangements
  - Ventilation pressures at strategic locations
- Notice of alteration to fan settings
- Notification of persons affected
- Alteration of booster fan, main fan and gas monitoring alarm settings
- Change validation
- Ventilation model update

BOOSTER FAN STARTING

- Single main fan operating (must be in place before booster fans can be started)
- Status check – main fan collar pressure, gas, pressure & condition monitoring at booster fan.
- Start booster fans and increase speed to intermediate level (speed increases automatically)
- By-pass door closes with increasing pressure (relies solely on ventilation pressure for operation)

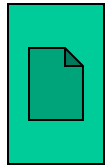
BOOSTER FAN STARTING

- Start second main fan (manual, will not start unless booster fans are running at set intermediate speed)
- Increase booster fan to authorised operating duty

  (Happens automatically)
- Status check – main fan collar pressure, gas, pressure & condition monitoring at booster fan
- Adjust mine regulators as required
- Confirm gas and ventilation monitoring

BOOSTER FAN STOPPING

- Normal fan operation – twin main fans, twin booster fans, maingate borehole fan
- When one booster fan trips the second booster fan is shutdown
- By-pass door opens
- One of the main surface fans trips (No2.)
- The development feeder power is isolated
- Status check – main fan collar pressure, gas, booster fan installation gas, pressure & condition monitoring
- Confirm reason for booster fan stoppage
- Underground controller to notify Shift Supervisor and ERZ controllers
- Review regulator settings where booster fan outage to be extended



INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

PLANNED SHUTDOWN

- **Booster fans to be shutdown periodically in a controlled and planned manner for maintenance purposes.**
- **Represents a Major Ventilation Change – written authorisation of Ventilation Officer, countersigned by Mine Manager.**
- **Except in the case of emergencies, requires:**
  - **24 hours notice**
  - **Formal request with scope of work to be performed during shutdown, prepared by department seeking the shutdown.**

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

FAILURE MODES

- Loss of power to mine site
- Loss of underground power
- Loss of underground power, other than the booster fan feed
- Failure of both main fans
- Failure of a single main fan
- Failure of both boosters fans

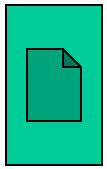
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

FAILURE MODES

- Failure of a single booster fan
- Failure of maingate borehole fan
- ERZ trip at inbye interface
- By-pass door fails to open when booster fans shutdown
- By-pass door fails to close when booster fans powered up
- Failure of Communications

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

BYPASS DOORS



- Door held closed during normal operation
- Door partially open – nil pressure condition
- Door open upon booster fan failure
- Door restrained from opening fully to enable closure on booster fan restart.

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

INSTALLATION

Fans delivered to mine site in June/July 2002

Work began in September 2002 with secondary support work and site clean up.

Began Excavating booster fan sites October 2002

Completed Excavating sites December 26th 2002

Laying concrete January

Erecting fans February/March

Electrical installation occurred in parallel with other tasks

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

EXCAVATION

Removal of 3.0m coal caunch at I hdg went well

Thickness of concrete work underestimated

G heading fan site concrete excavated approx. 1.0m thick

Concrete had mesh and roof bolts embedded inside

Excavated using combination of the following;-

- **Trencher Machine to cut 700mm deep "slots" to make excavations easier;**
- **Machine mounted jack picks hired (mixed success)**
- **Manual jack picking (brute strength).**

CONCRETE WORKS

Concrete works responsibility of fan supplier (Flackt-Woods)

Concrete 40 MPa spec with reinforcing to Australian Standards

60 m^3 per fan site, 120 m^3 total

Subcontractor experienced difficulties in that the Reo bar supplied from supplier in Townsville was incorrectly manufactured

Subcontractor utilised steel purpose designed formwork – resulted in and excellent finished product

Utilised specialist concreter to supervise the concrete works

FAN INSTALLATION

Fan installation and build up went smoothly

Flackt-Woods supervised subcontractor installing fans

Fan impellors delivered on purpose designed skids for ease of transport

Fan supplied in parts to specified sizes for transport underground.

Utilised existing skid for transportation of fan parts where reqd

Motors heaviest item (5.5 tonnes)

Surveyed transport route prior to order to identify load restrictions

ELECTRICAL INSTALLATION

Used contractors where possible to minimise drain on mine resources

Changed schedule to allow electrical installation to occur in parallel with other operations

Termination of heavy power cables from fan substation to fan motors more difficult than expected

Fan supplier clearly did not understand requirements of Qld legislation for electrical equipment such as monitors

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

ELECTRICAL INSTALLATION

On site support from substation and motor suppliers was good

Off site testing of substation with actual fan motor saved time during commissioning

Very few problems encountered during the commissioning that were related to the booster fan electrical installation

VVVF drives proven very effective in operation

Some problems encountered with the fibre optic line installation

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

COMMISSIONING

Commissioning period extended due to factors not related to the booster fan installation;-

- **Delayed commissioning due to poor roof on Longwall**
- **Major repairs to Trunk belt (splicing)**
- **Requirement to weld on the Longwall face**
- **Waiting for window for development panel extension**
- **Major fault #2 surface fan only 1 fan available for 2 days**
- **Major unplanned power outage to site during commissioning**

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

COMMISSIONING

Actual commissioning period on booster fans was 5 days

Some problems encountered;-

I hdg motor coupling moved slightly (bedding in)

One vibration sensor on I hdg fan reading normal but plc interpreted as trip (calibration problem)

One pressure sensor had blockage in stainless steel tubing run for pressure readings (not sensor problem)

Need to dismantle and rebuild 24 I-J stopping to allow 2 surface fan operation (due to welding on LW)

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

COMMISSIONING

There were many positives to the commissioning stage;-

The electrical systems worked very well

Electrical interlocks were all physically tested – all worked

Both fans ran smoothly – temperatures & vibrations were all well within limits and stable

Ventilation pressures and quantities were all very close to those modelled – verifying and adding confidence to accuracy of the ventilation model

Due to the outside problems, the commissioning was very flexible – this was able to be done and still achieve all objectives

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

COMMISSIONING

Support from OEMs was good, especially with the stop/start nature of the commissioning

Able to test single fan operation of each booster fan (important information for future)

Able to run each booster fan up to full RPM

Proved the system including the designed interlocks and operation

Fans running and commissioning over on Friday 2nd May 3:15 pm

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

POST COMMISSIONING

Air quantities in mine are greatly improved;-

- **Longwall 52 m^3/s (52 m^3/s prior to booster fans);**
- **MG4N 98 m^3/s at Dogleg regulator (68 m^3/s prior to booster fans)**
- **Mains H heading 45 m^3/s (27 m^3/s prior to booster fans);**
- **Mains B heading inbye 35 c/t 35 m^3/s (8 m^3/s prior to booster fans).**

Pressures inbye booster fan increased from 700 Pa to 1300 Pa

Main fan collar pressure 1060 Pa (1140 prior to booster fans)

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

POST COMMISSIONING

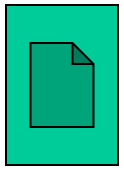
One point of note is that a very good fan curve has been developed for the booster fans.

Could be used for all fans.

Allows for accurate prediction of fan operation.

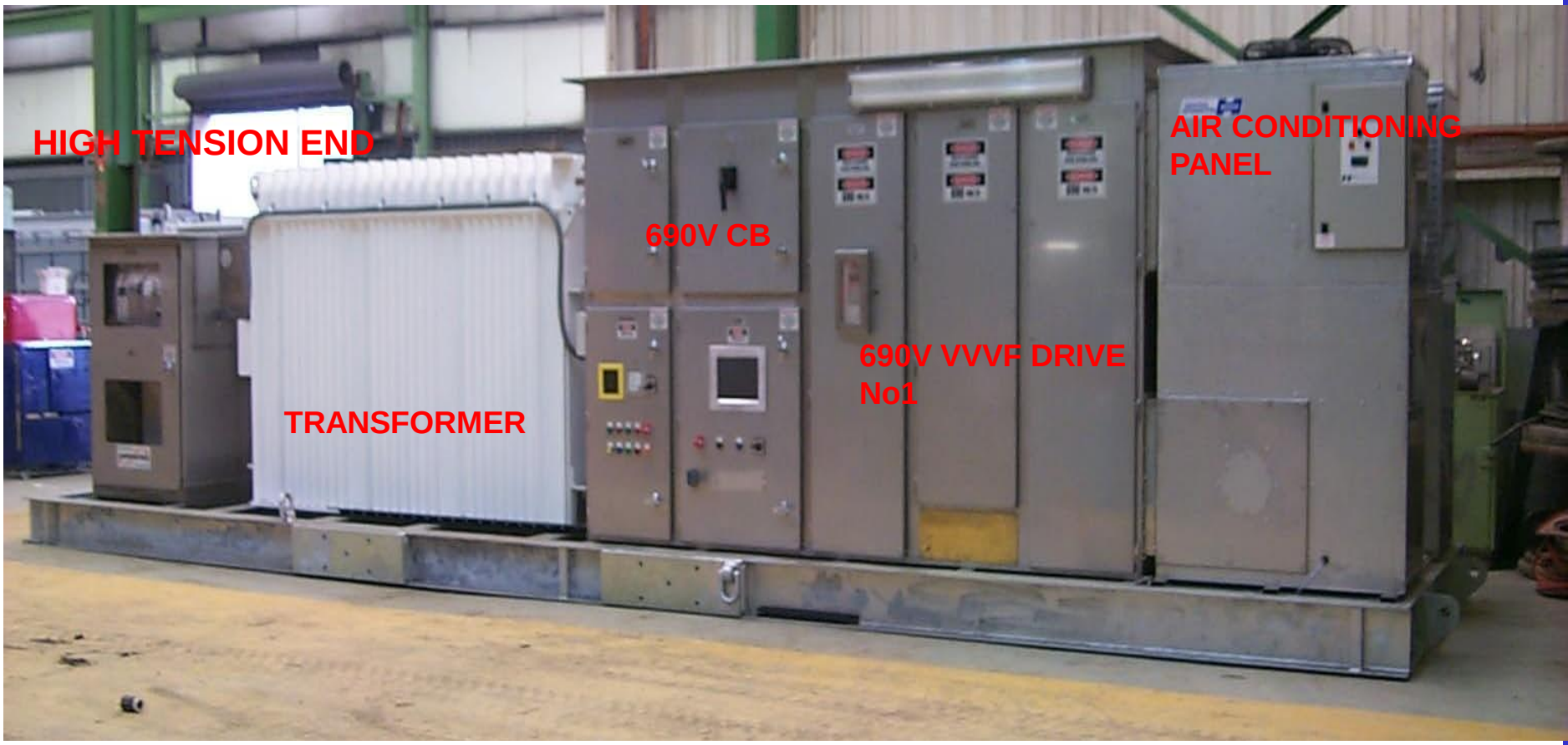
Excellent tool for future ventilation planning.

Developed by Geogas.

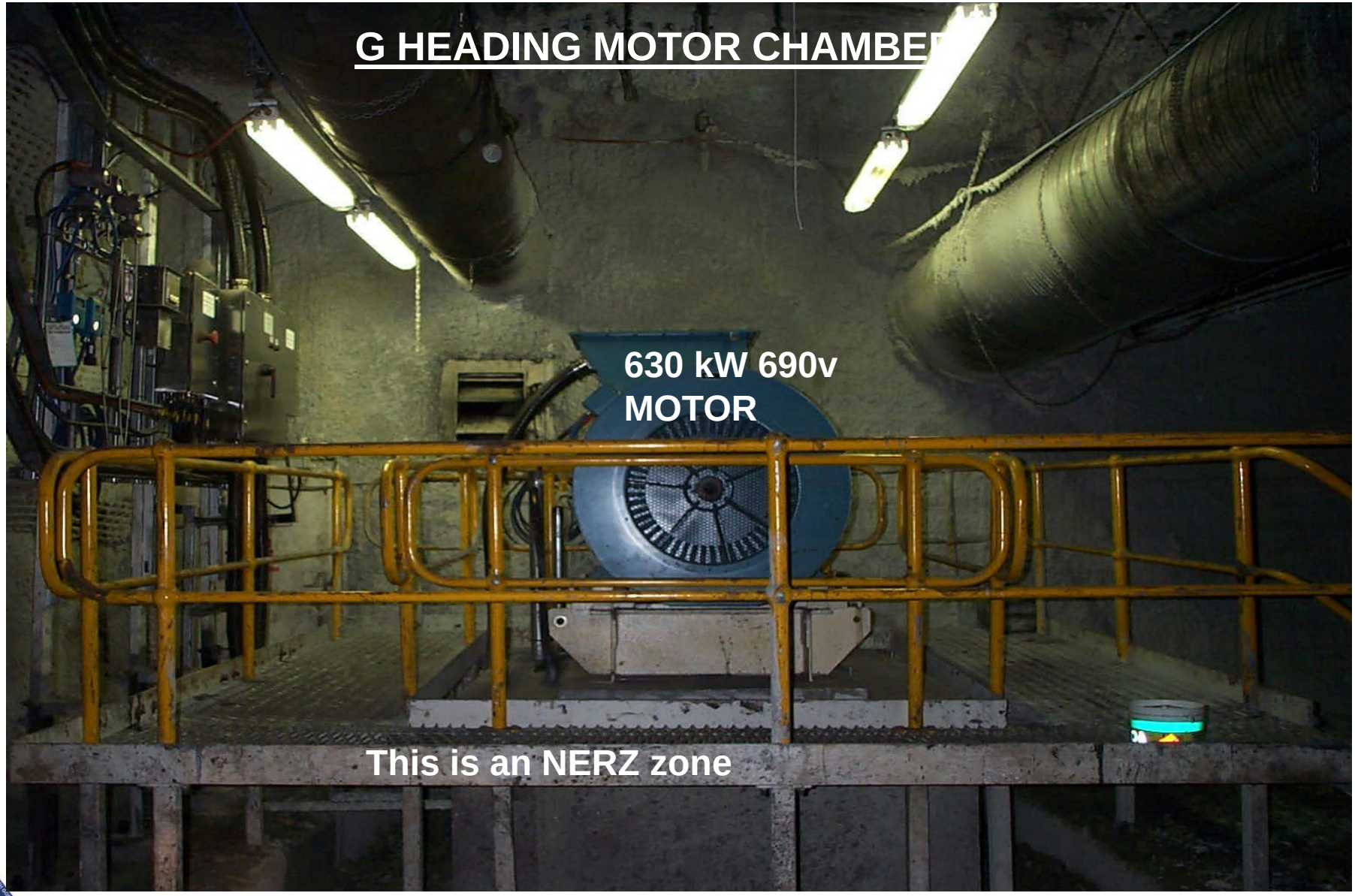


INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

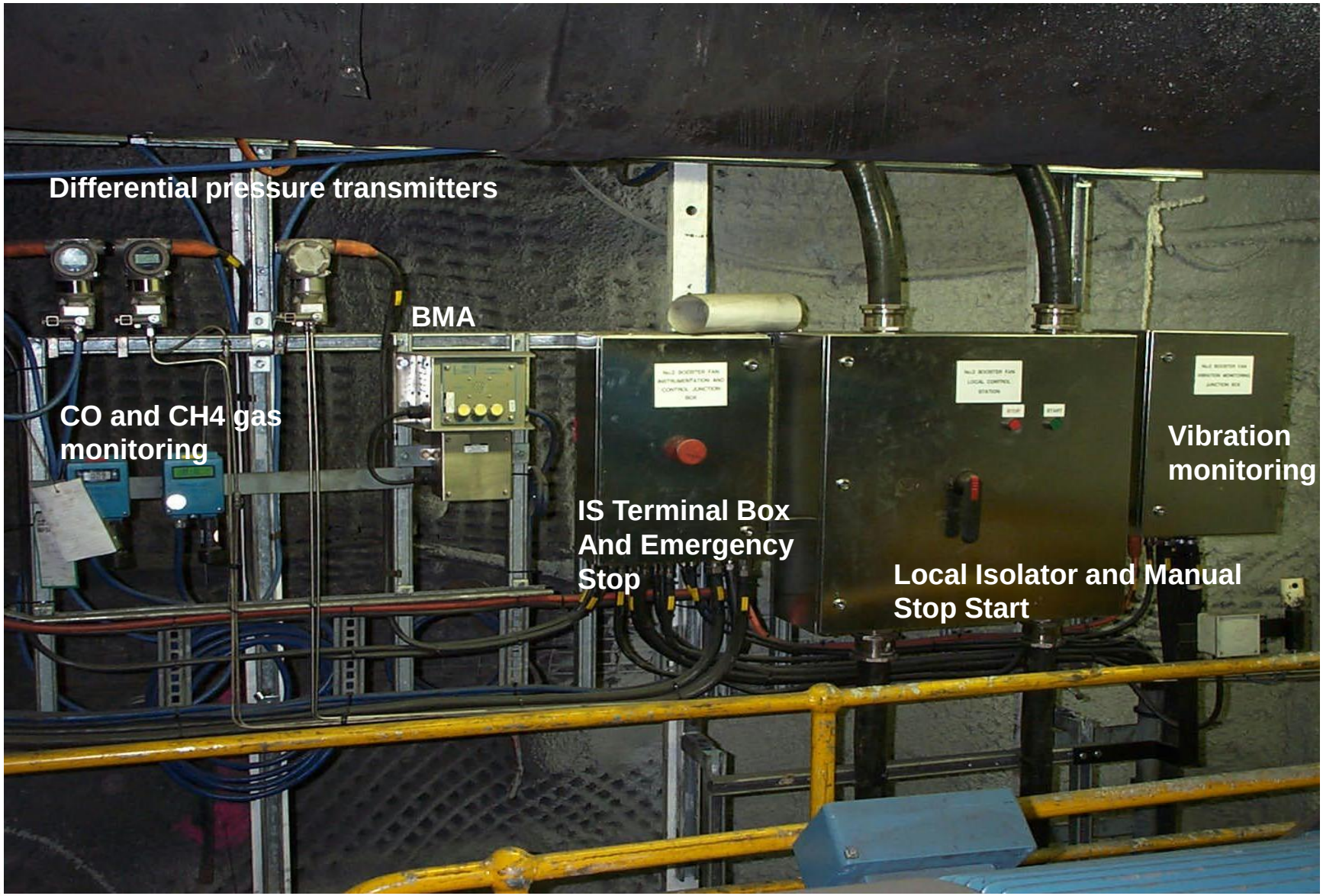
SUBSTATION



INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

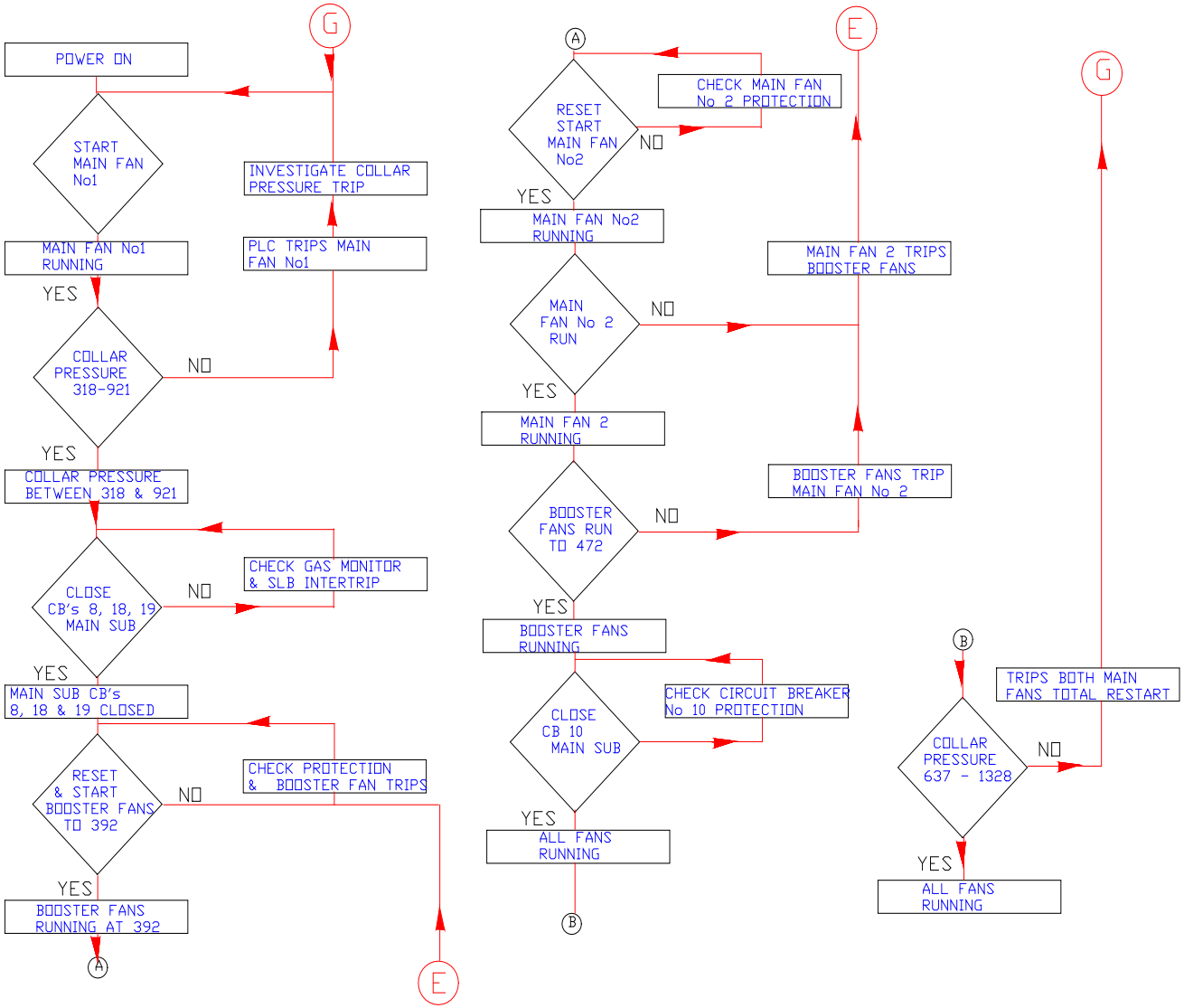


INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS



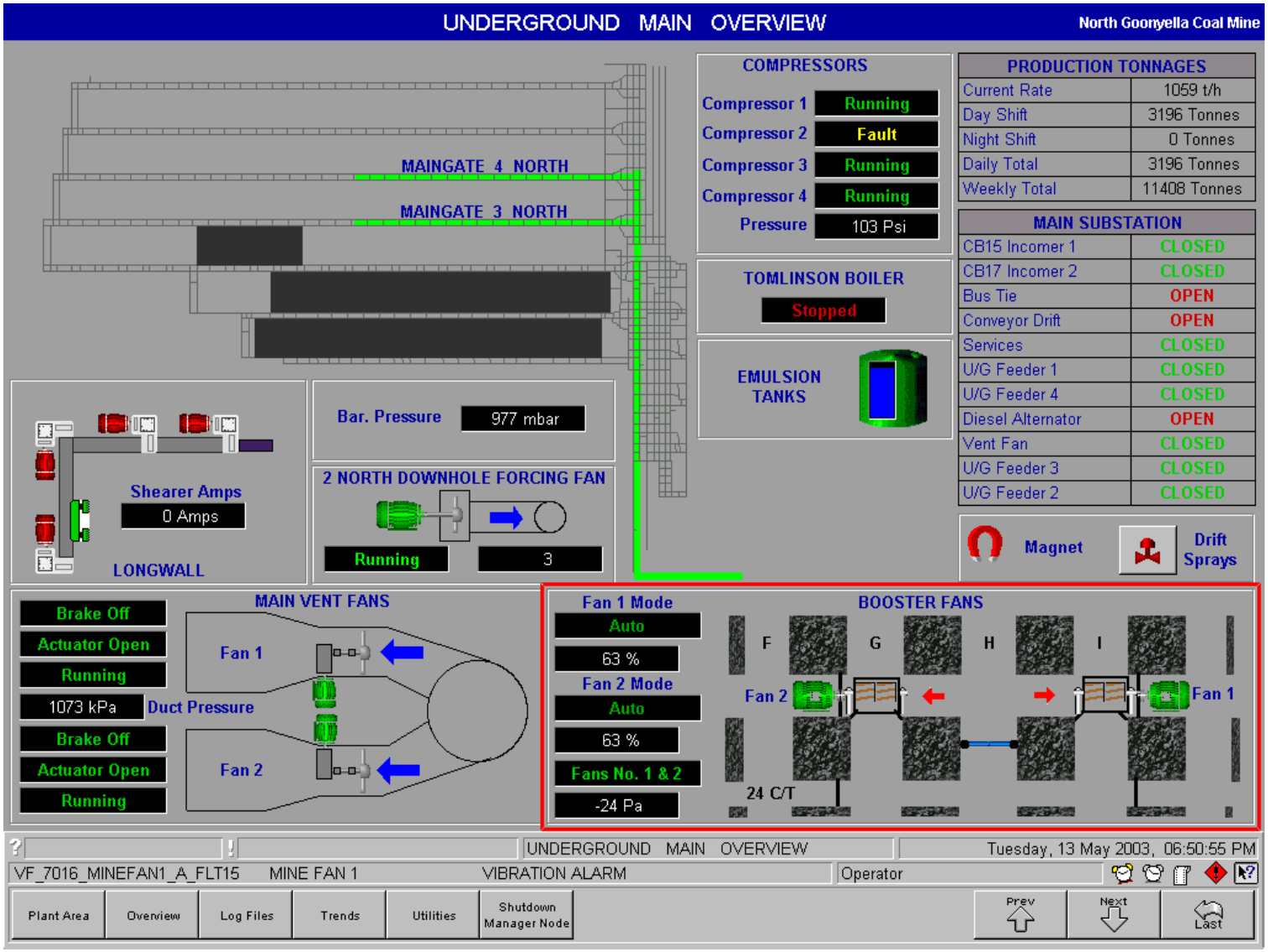
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

STARTUP FLOWCHART



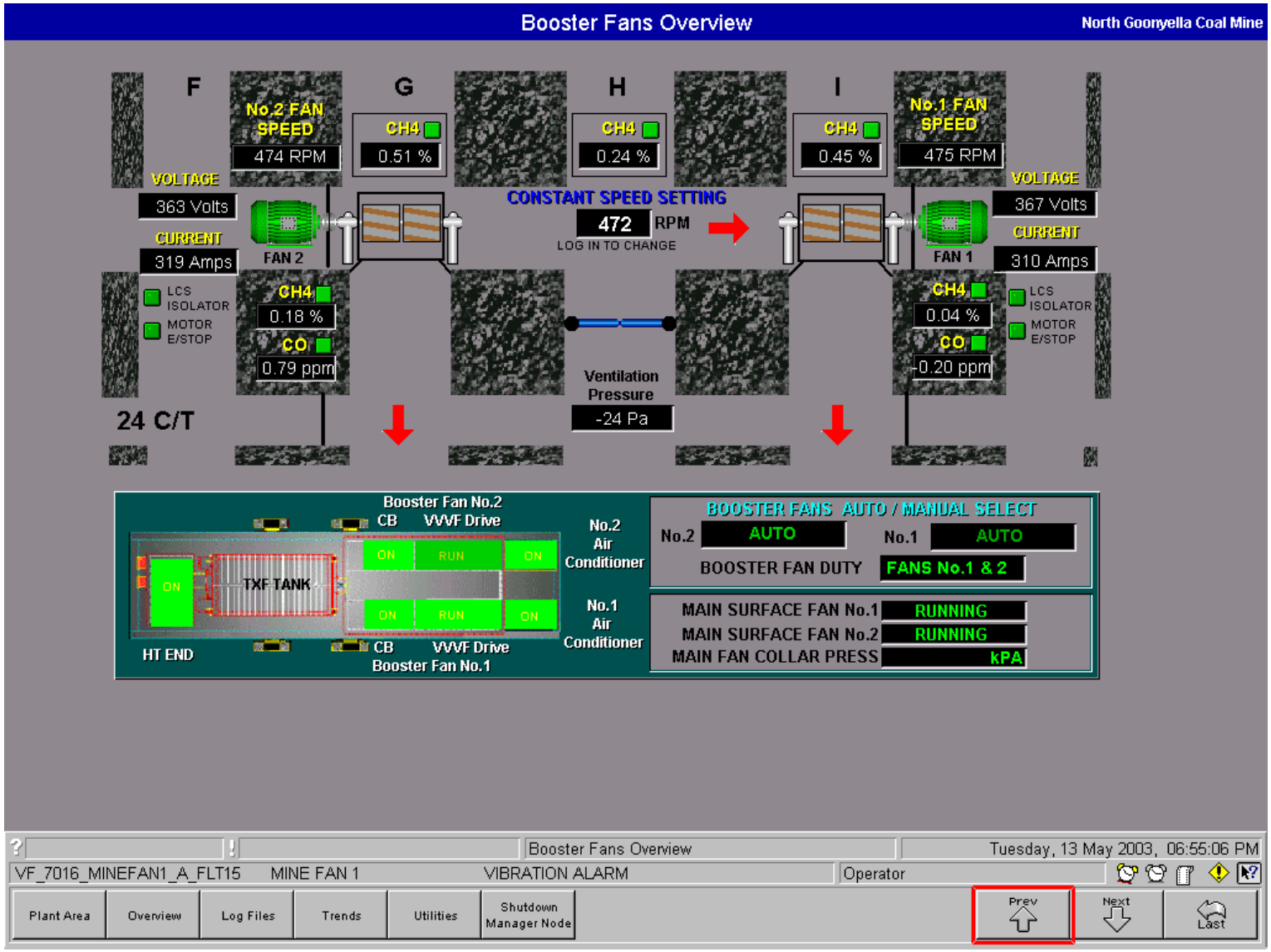
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

MAIN CITECT SCREEN (SURFACE CONTROL ROOM)



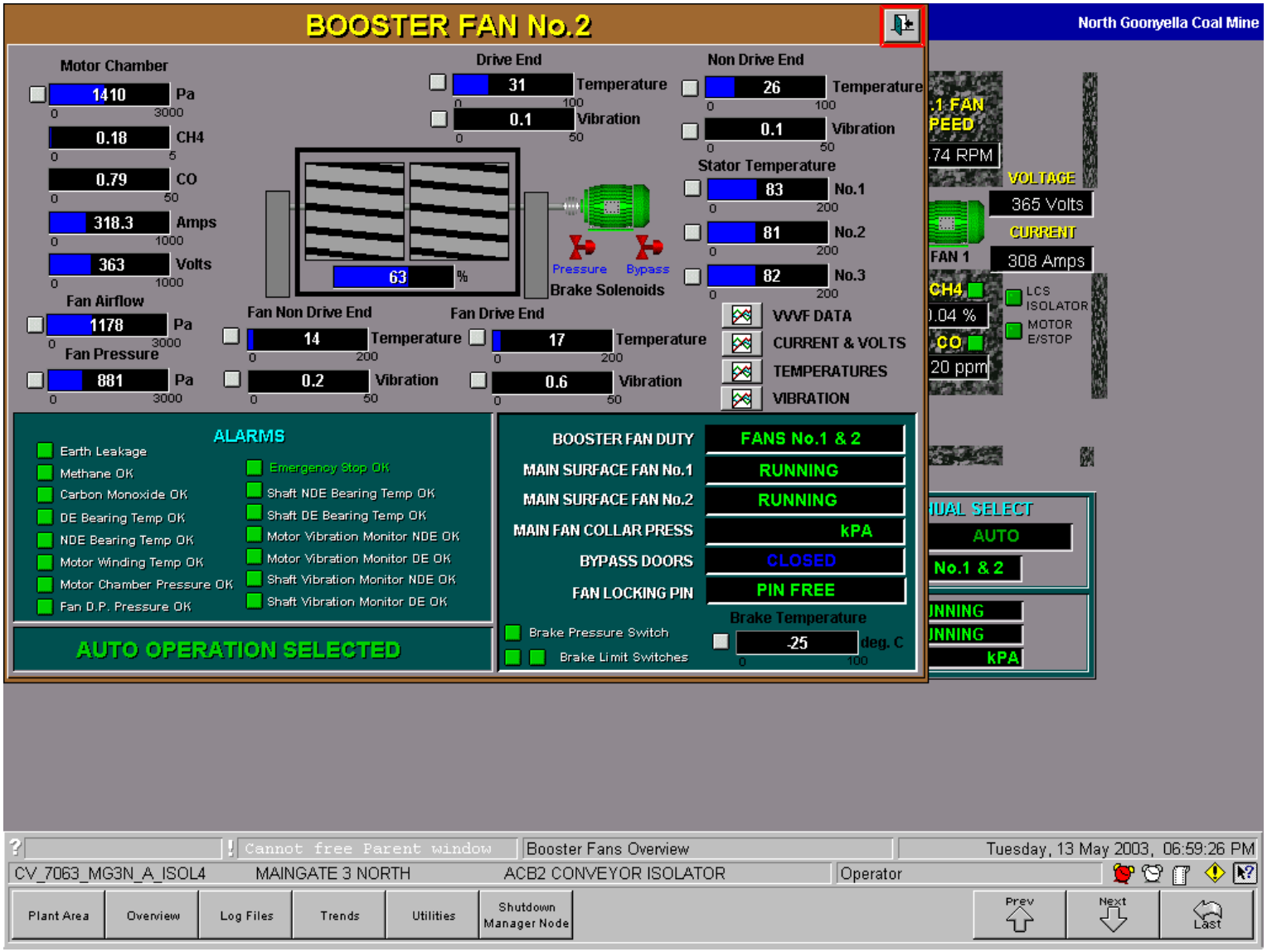
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

BOOSTER FAN OVERVIEW SCREEN



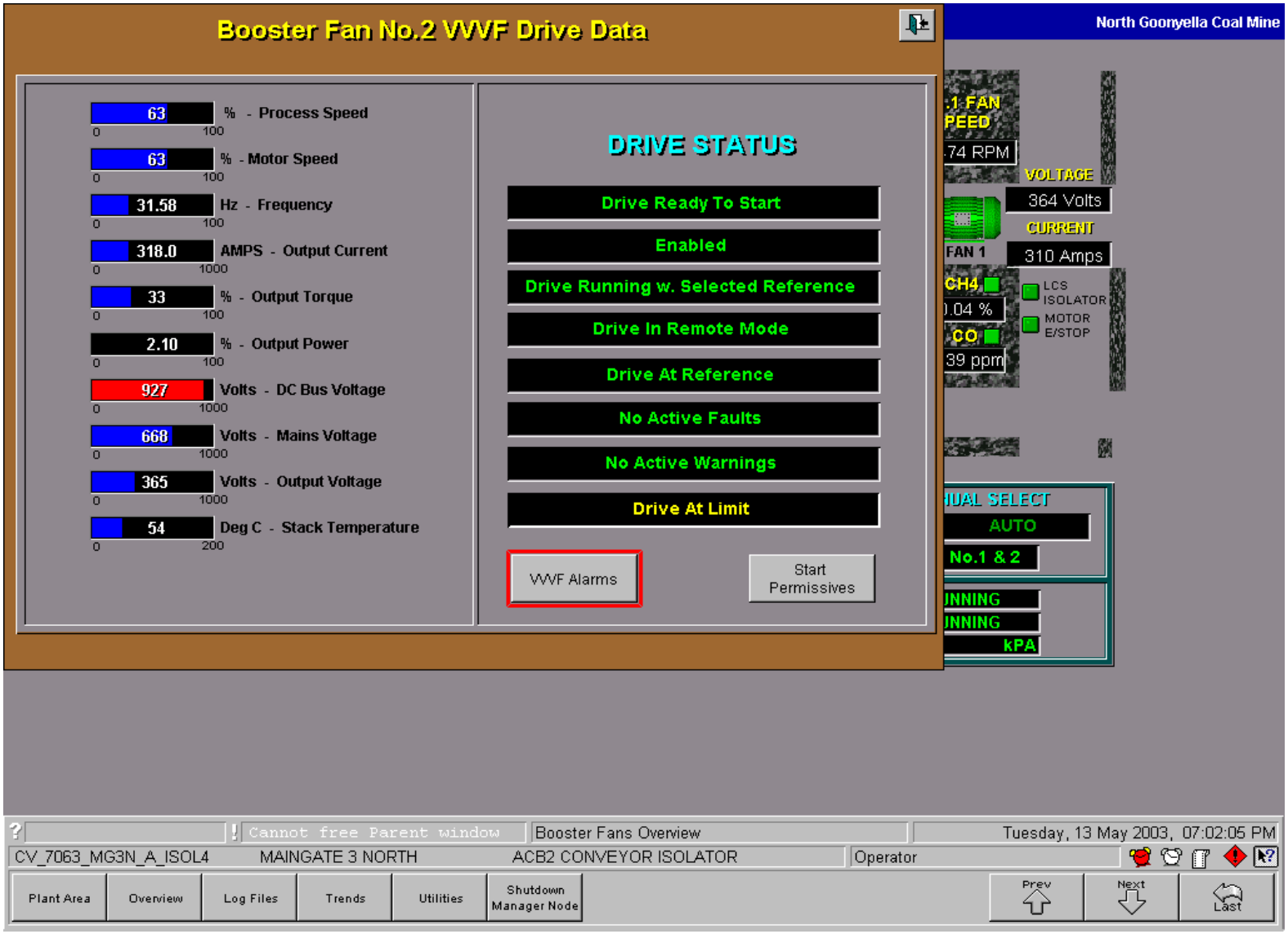
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

BOOSTER FAN DETAIL SCREEN



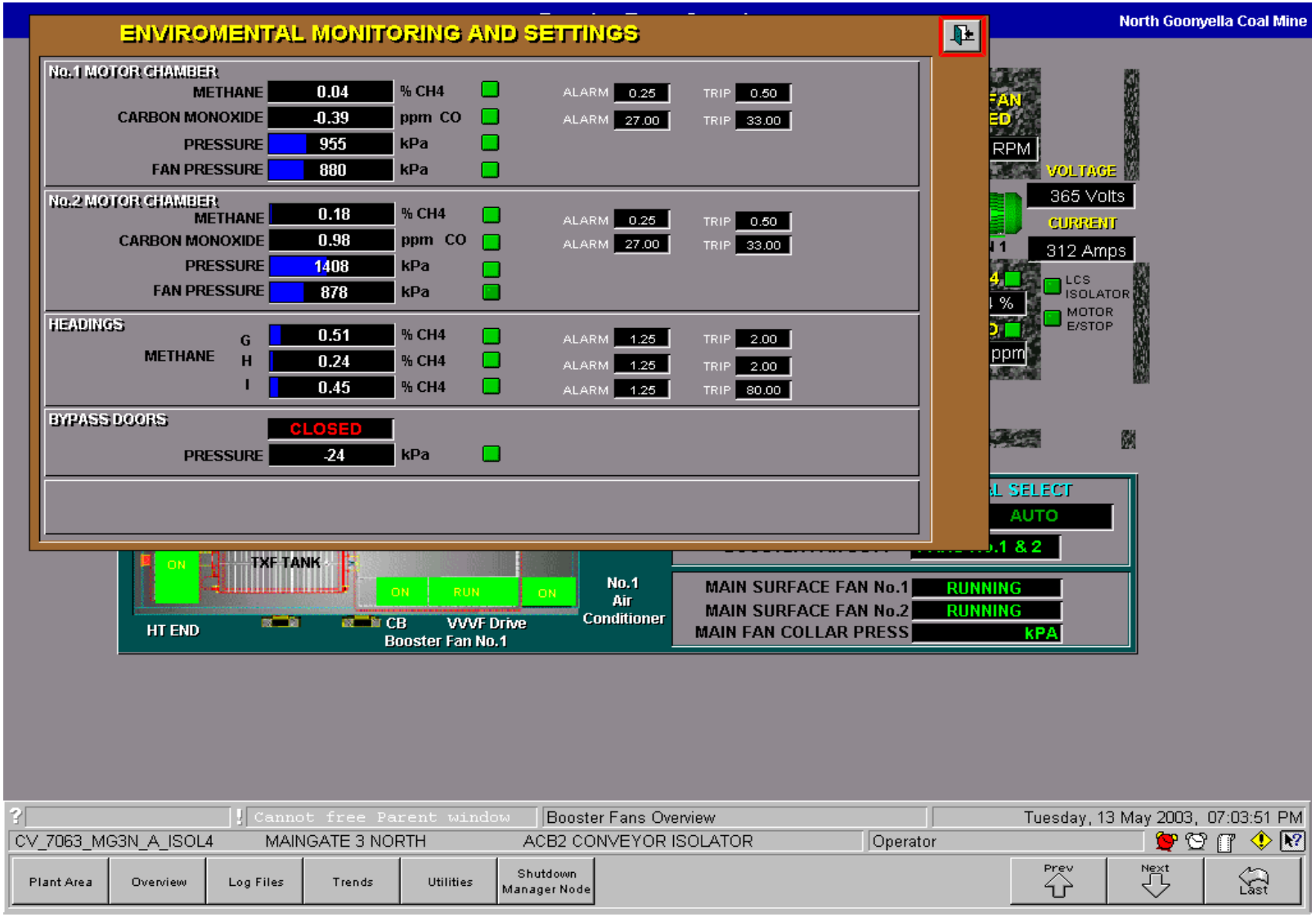
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

VVVF DRIVE DETAIL SCREEN



INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

ENVIRONMENTAL MONITORING DETAIL SCREEN



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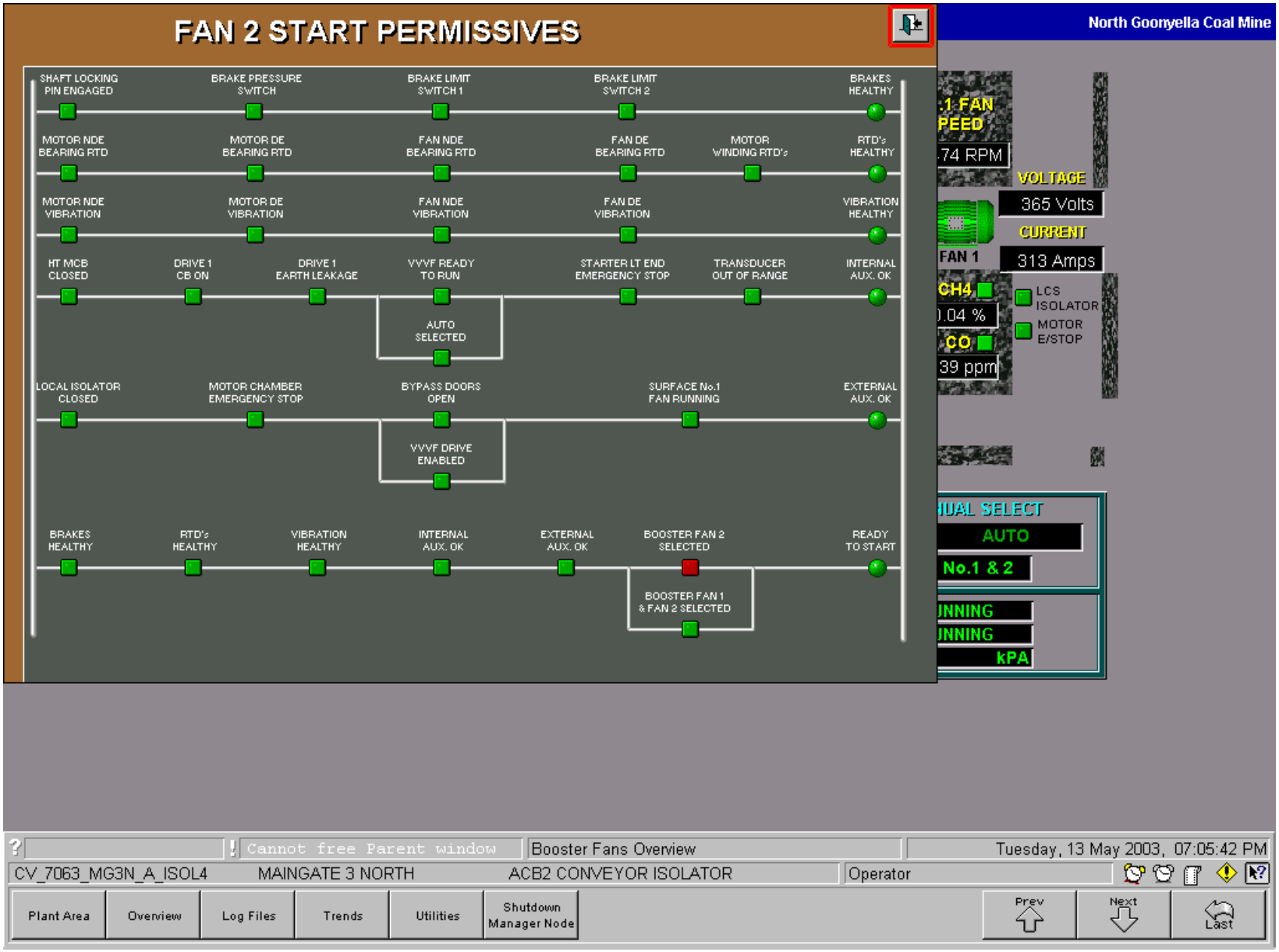

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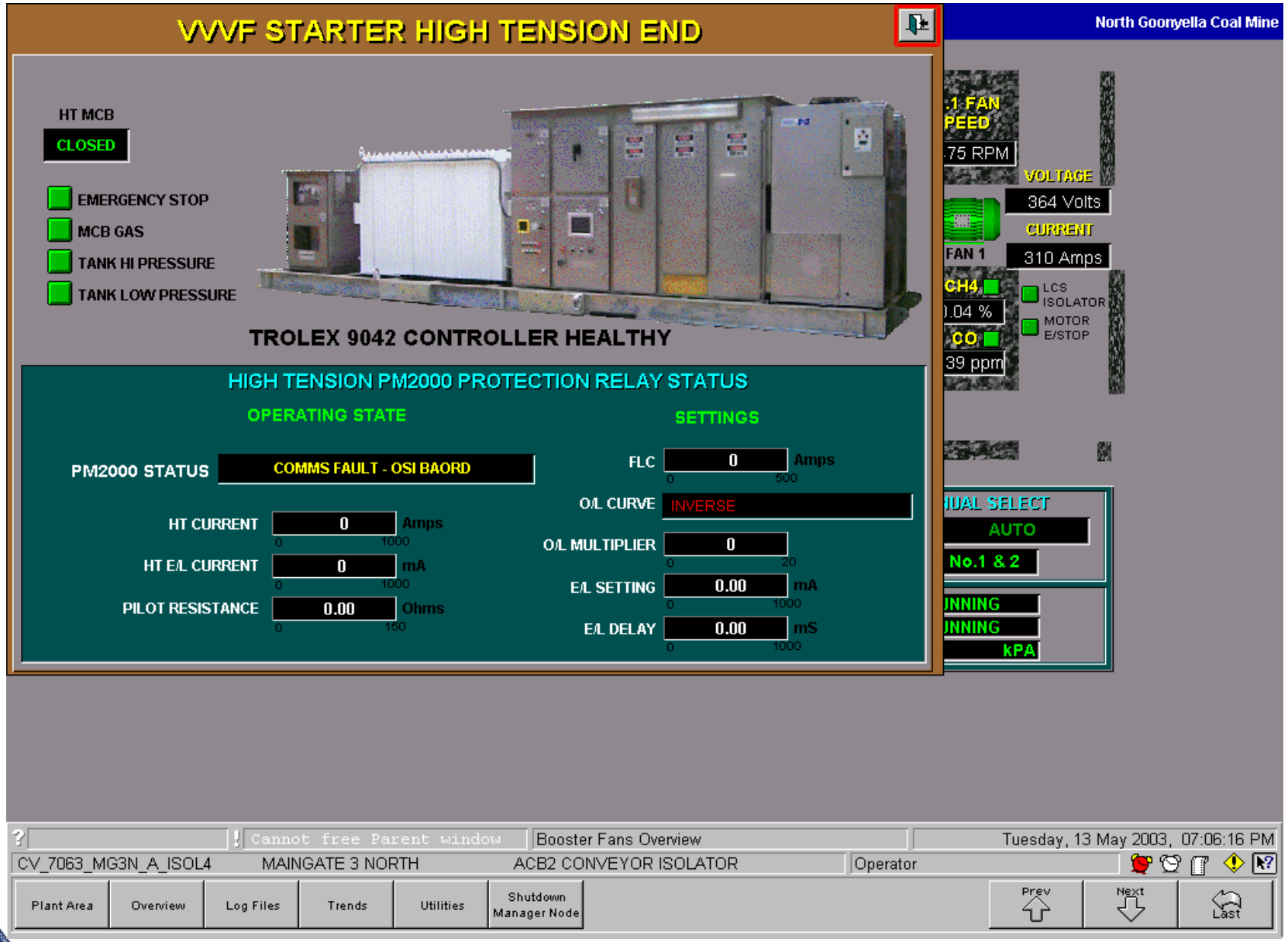

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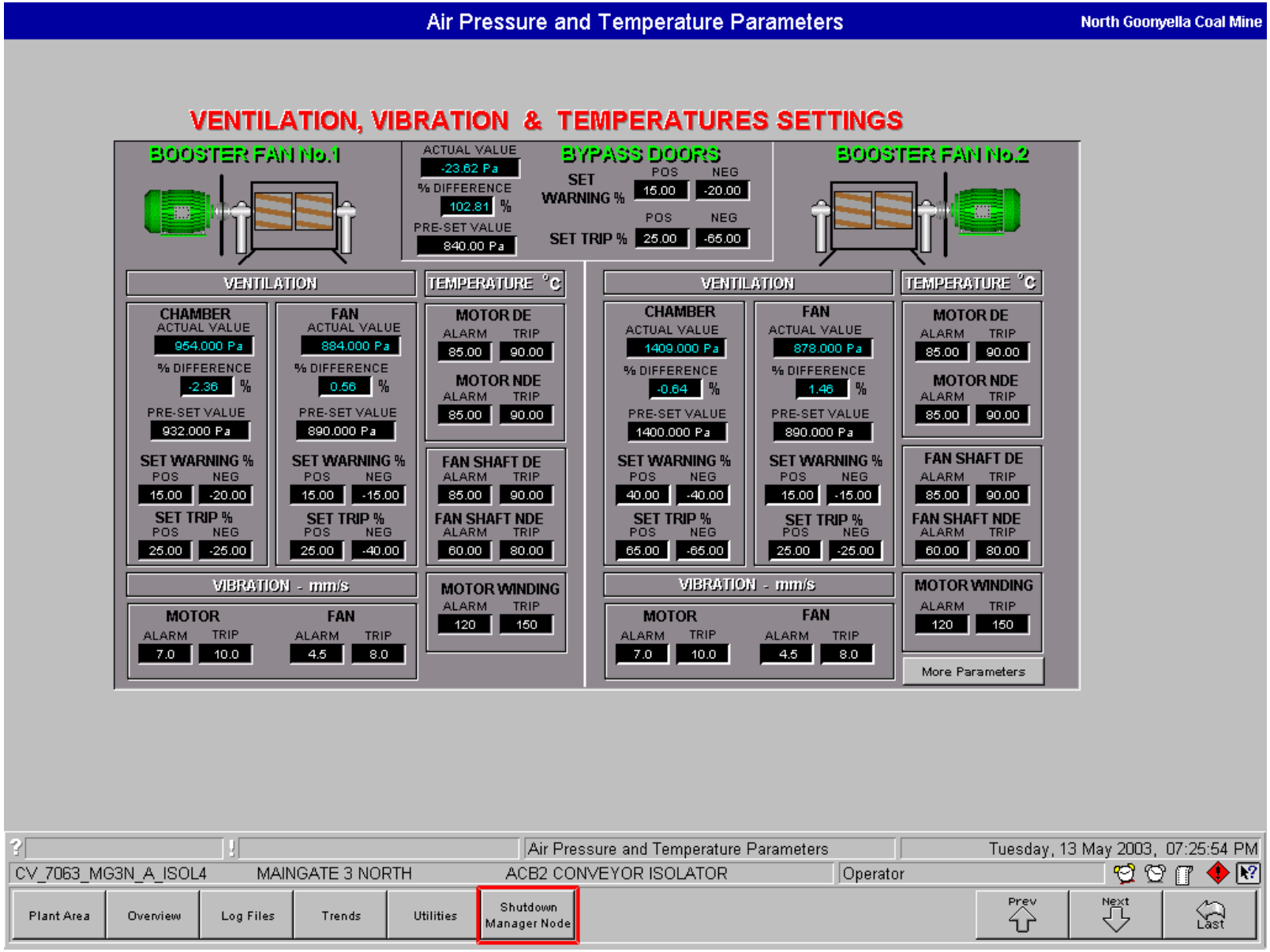
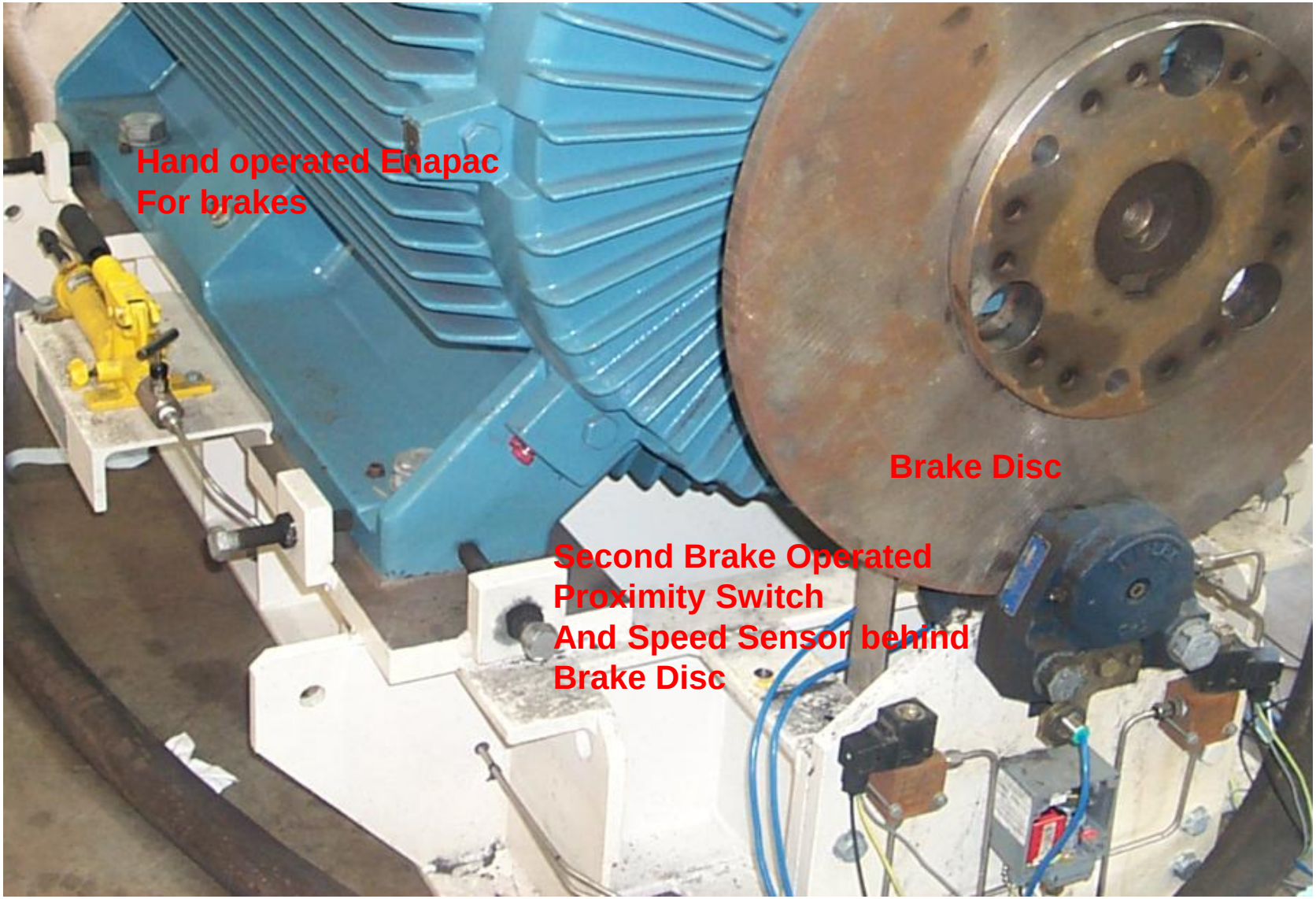


INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

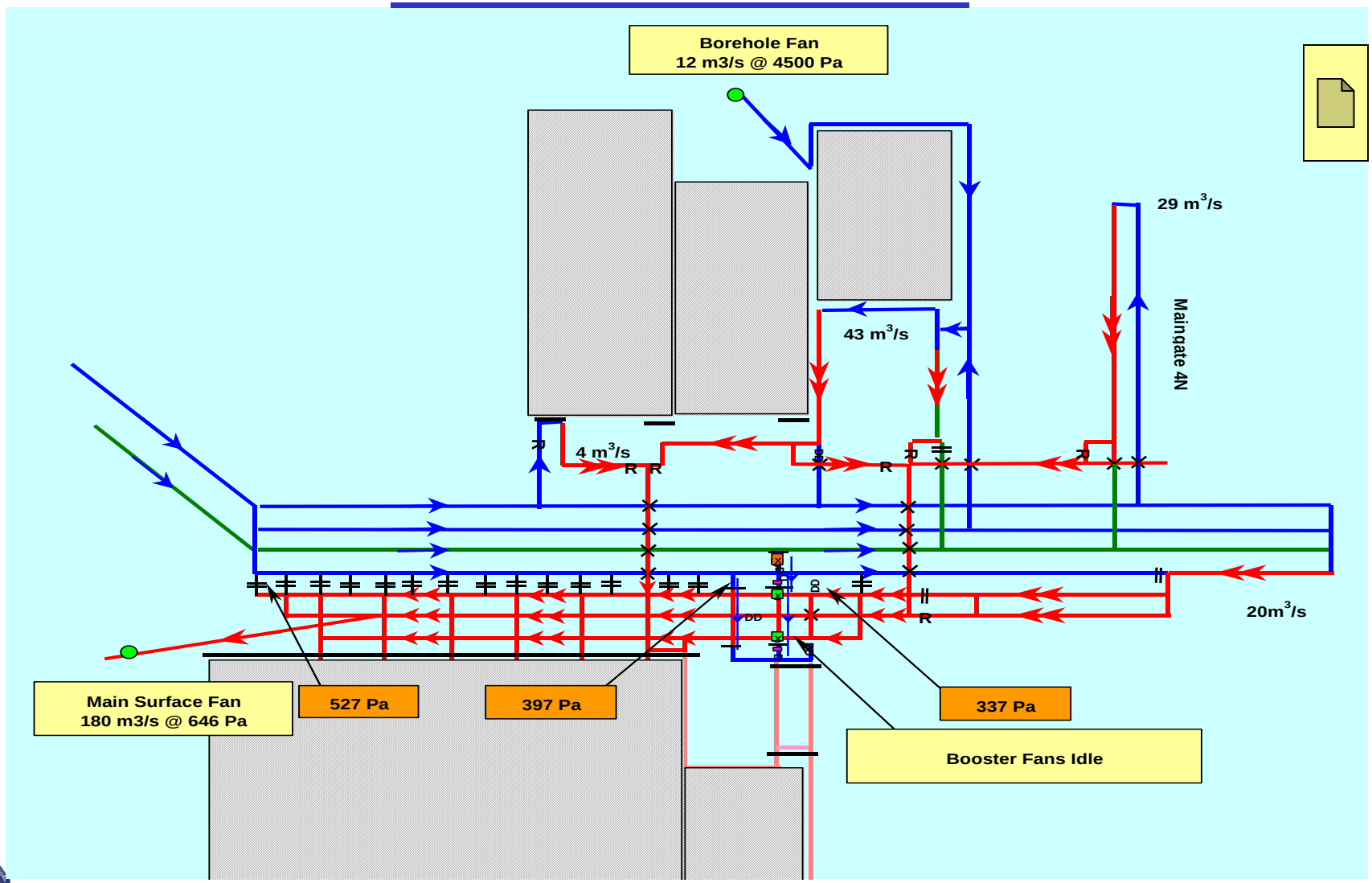
MOTOR SHOWING SHAFT HOLDING BRAKE ASSEMBLY



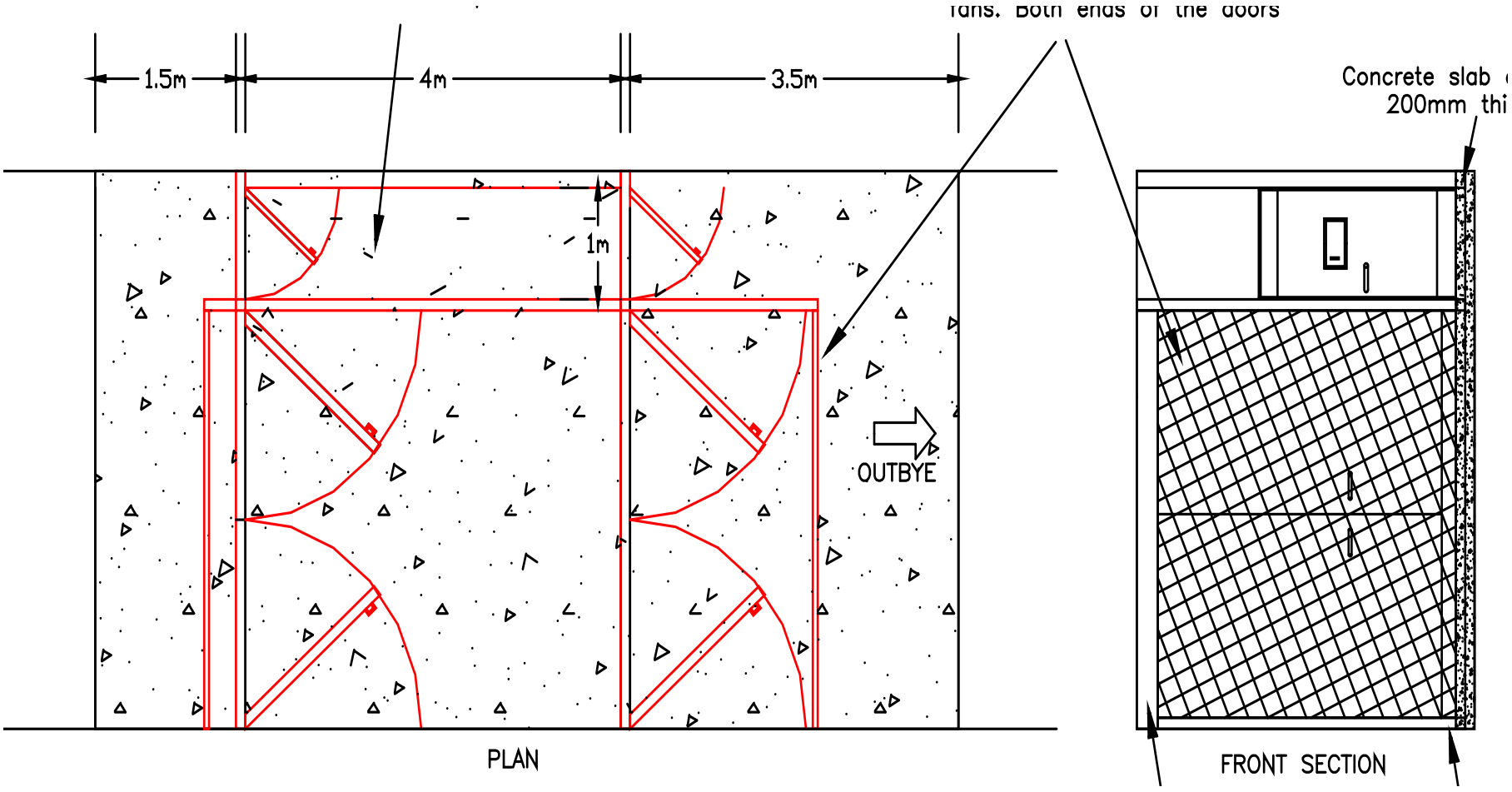
THE INSTALLATION OF UNDERGROUND BOOSTER FANS AT NORTH GOONYELLA COAL MINE

INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

BOOSTER FANS STOPPED -
Effect on Mine Ventilation



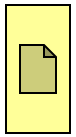
Bypass Door Schematic



INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

COMBINED OPERATING DUTIES

MG4N	200 m^3/s	@ 1 kPa	290 kW
MG5N	270 m^3/s	@ 1.4 kPa	520 kW
MG6N	290 m^3/s	@ 1.8 kPa	700 kW
MG8N	300 m^3/s	@ 2.4 kPa	970 kW
MG9N	270 m^3/s	@ 1.7 kPa	640 kW



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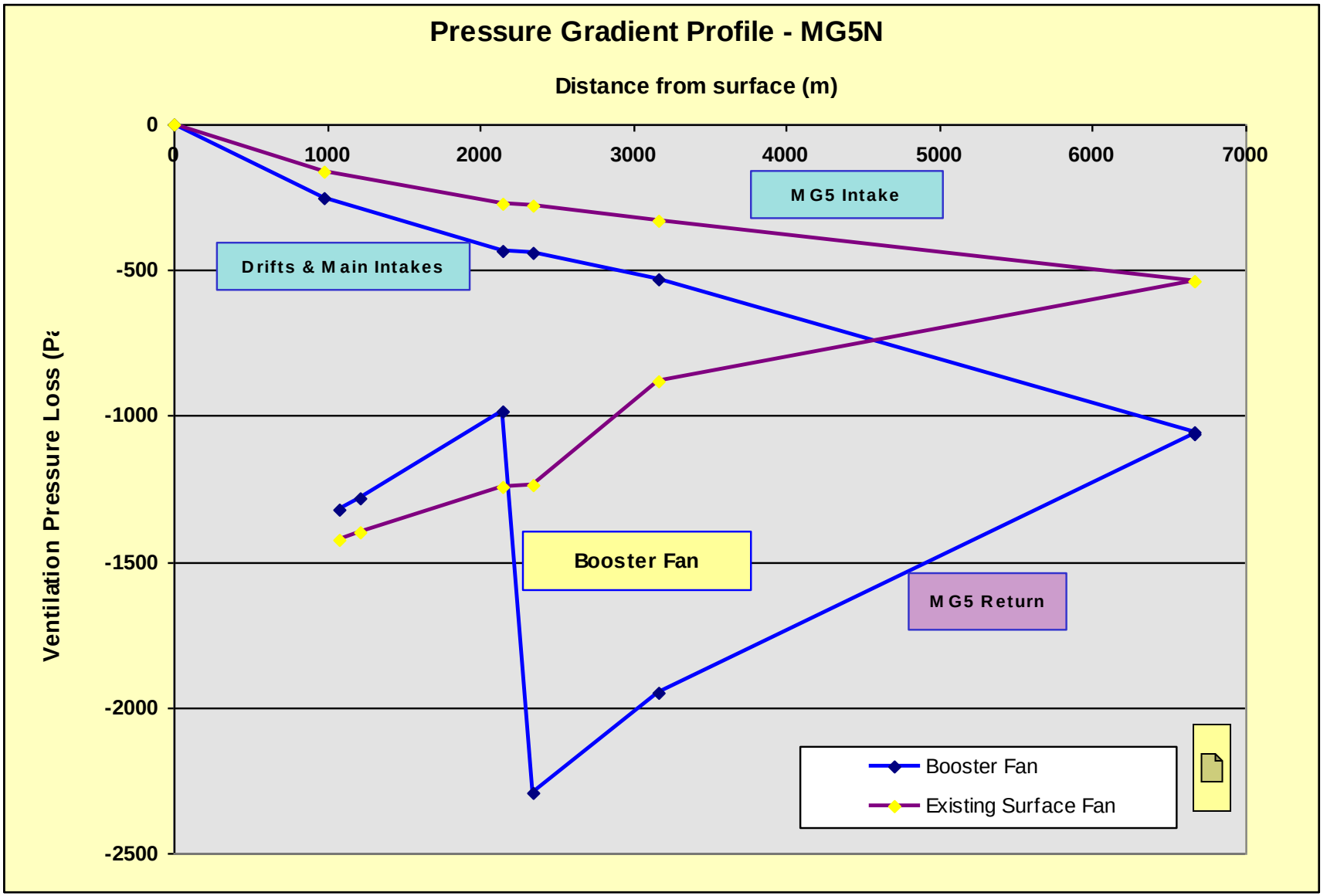
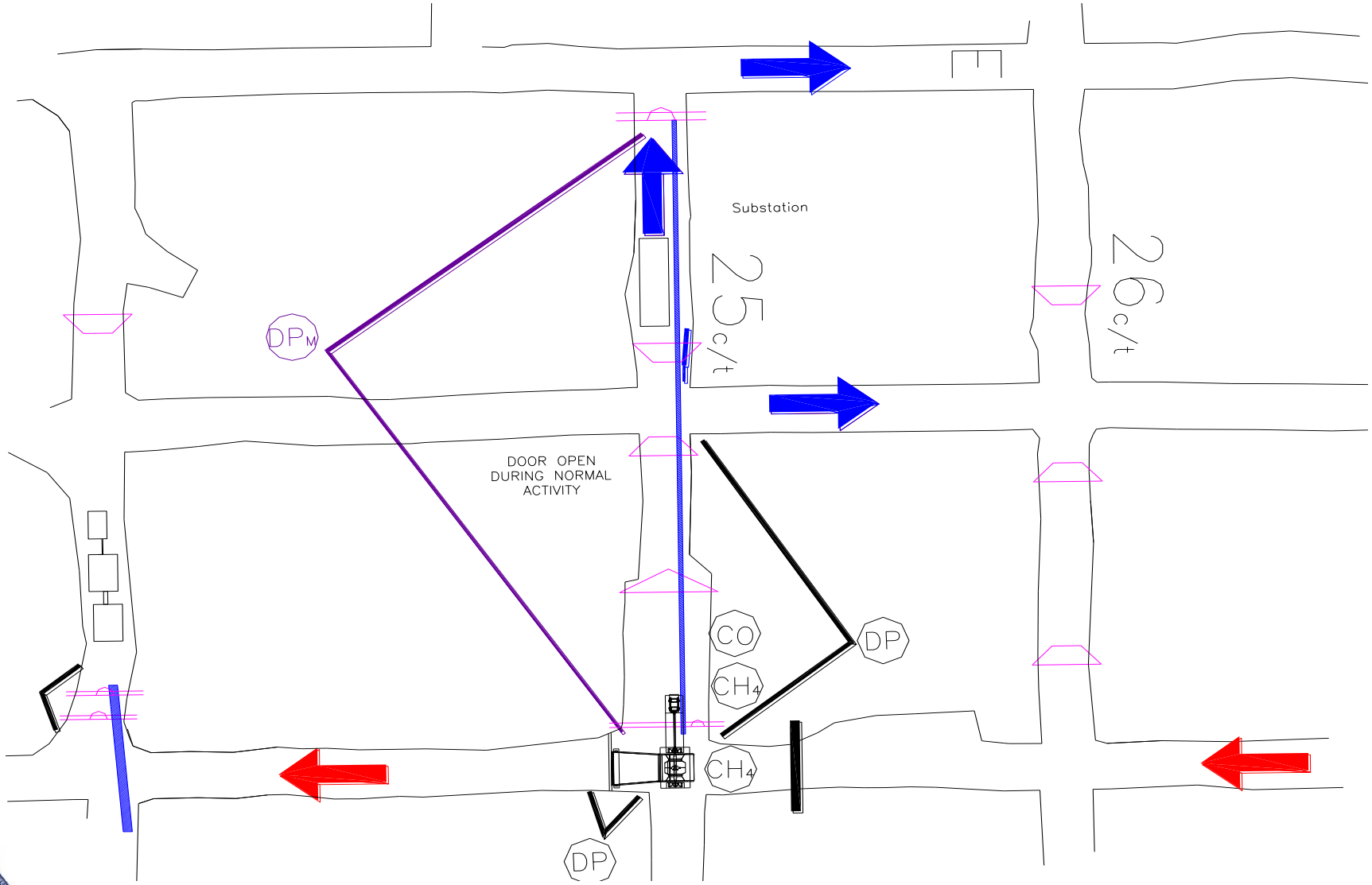


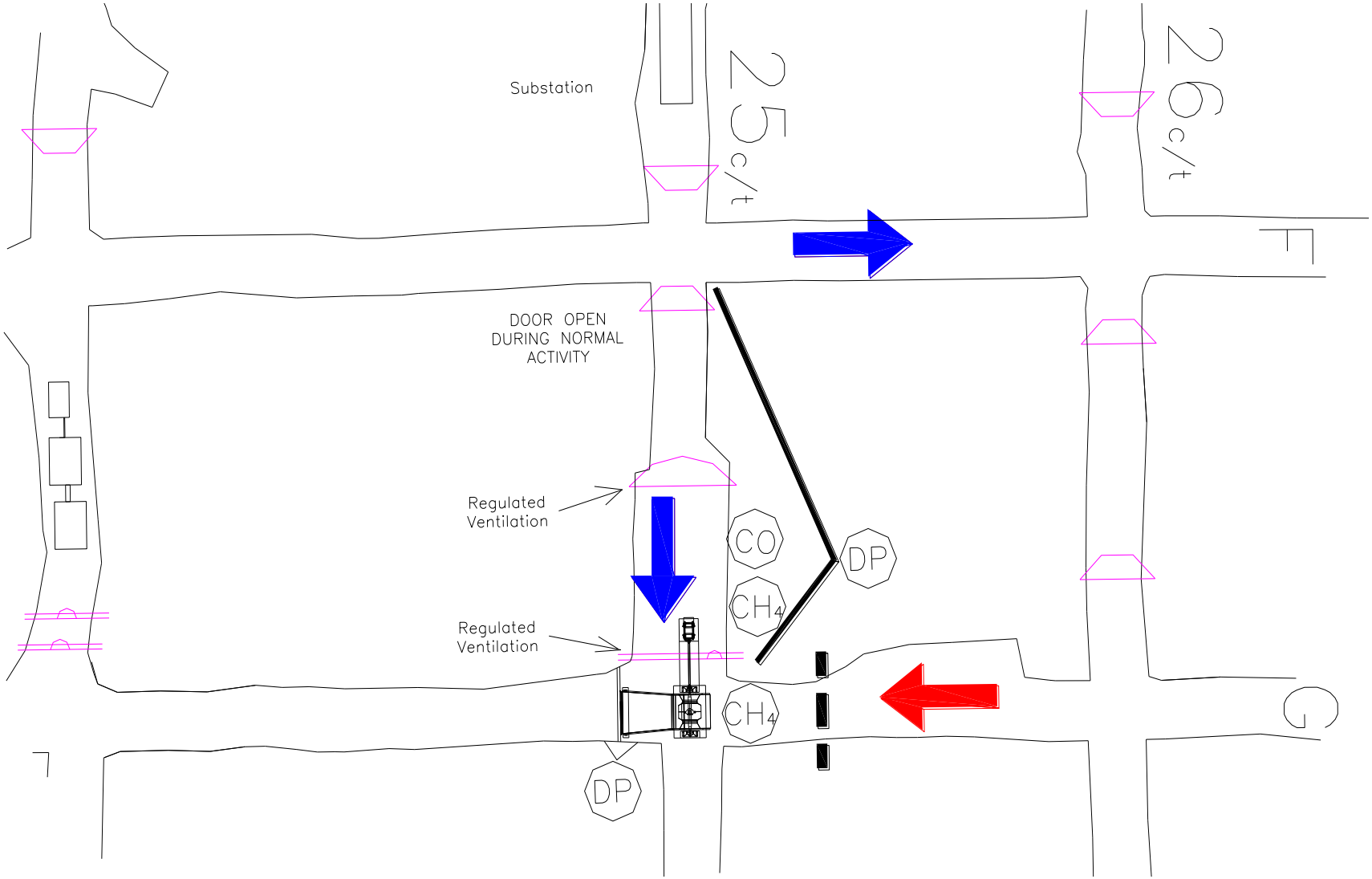
INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

SUBSTATION VENTILATION



INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

G Hdg MOTOR CHAMBER VENTILATION



INSTALLATION AND OPERATION OF UNDERGROUND BOOSTER FANS

I Hdg MOTOR CHAMBER VENTILATION