

**IN THE GRENFELL TOWER PUBLIC INQUIRY**

**THE INQUIRY RULES 2006, RULE 9**

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**EXHIBIT 1 TO THE  
WITNESS STATEMENT OF  
MICHAL GLOWACKI**

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<b>Exhibit</b>	<b>Description</b>
MG/1	Note titled ‘The HMI Panel and the Operation of the Fireman’s Override Switch “HMI FOS Switch”’

## **THE GRENFELL TOWER INQUIRY**

### **THE SMOKE CONTROL SYSTEM**

#### **THE HMI PANEL AND THE OPERATION OF THE FIREMAN'S OVERRIDE SWITCH ("HMI FOS Switch")**

##### **NOTE**

##### **Dr Lane's Position – HMI FOS Switch**

Dr Lane states as follows (at BLAS0000031\_0095):

*11. My team's analysis of the programming shows that switching the HMI from "Auto" to "On" and back to "Auto" resets the AOVs such that the AOVs open on the lowest floor of smoke operation since the panel first activated. The fans continue to run.*

Dr Lane uses the following example to explain the analysis:

*For example, in the event of a fire on Level 7, if smoke spreads through the building and is present on Levels 4 to 9, and the system is turned from Auto to On to Auto, then the system would open the damper on Level 4 as it is the lowest floor in the building on which smoke had been detected at the time of the change of operation.*

##### **RINA Tech's Position – HMI FOS Switch**

RINA Tech, in appearing to describe the same scenario, reach a different conclusion as to how the System would have responded.

RINA Tech put forward the following theory (at MET00072161\_0021-0022):

*Simulating the system confirmed that:*

- *From environmental or standby mode, simulating smoke detected on a floor would cause the dampers on that floor to open...*
- *Intentional operation, or the short-circuit of a lift lobby FOS on any given floor had no effect without the HMI FOS being switched on first.*
- *FOS activated on a floor would open the dampers on that floor and close the dampers on the floor that the first smoke was detected...*
- *On the deactivation of the HMI FOS switch, the system would revert to opening the dampers on the first smoke detected floor at the start of the fire, and close the remaining dampers.*

Using Dr Lane's example referred to above, RINA Tech appear to believe that the System would operate not on Level 4, as postulated by Dr Lane, but on Level 7 (assuming that the smoke detector on Level 7, being the original fire floor, was the first to activate).

##### **PSB's Position – HMI FOS Switch**

PSB do not believe that either Dr Lane or RINA Tech have correctly described the operation of the System in this scenario.

Based on the design for the ladder logic software on which the System's operation was based (as to which see further below), PSB consider that switching the HMI FOS from "on" back to "auto" while the System was operating in smoke control mode would have effectively reset the System such that it would

have been instructed to await a new smoke detection signal and would then have operated on the floor from which a smoke detected signal was first received following the reset.

As such, in the scenario referred to by Dr Lane as per the above, PSB consider that the System would have operated on the floor from which a smoke detected signal was first received following the switching of the HMI FOS back to “auto”. PSB believe that any of the levels with smoke present (any of Levels 4 to 9 in Dr Lane’s example) could have been the first to be activated in smoke control mode in this scenario.

While the System does read inputs and command outputs from the outstations in sequence, going from the lowest level to the highest in a communication loop,<sup>1</sup> the location of the first activation would depend upon the precise sequence of smoke detectors powering up, being activated by smoke and being read in the communication loop. For these reasons, any of the levels with smoke present could have been the first to be activated in this scenario.

The precise operation of the System ladder logic in this scenario is technical and complex. In headline terms, however, the mechanism described above is based on the following inputs / command outputs within the ladder logic occurring in the event that the HMI FOS was switched from “on” back to “auto” while the System was operating in smoke control mode:

1. The System would clear the stored value of the activated fire zone from the System and for 8 seconds would not read any new smoke detected signals.
2. The System would cut off power to the smoke detectors for 8 seconds to allow them to reset.
3. After 8 seconds, the System would restore power to the smoke detectors and resume monitoring them for a new activated fire zone.

This operation is demonstrated by the following extracts from the print-out of the System’s ladder logic program:

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<sup>1</sup> With the exception of Ground Level and Level 1, which were connected directly to the Master Control Panel and therefore read more often

Line 86 (and other fire detection rungs)

The fire detection rungs within the ladder (rungs 3 to 28 / lines 64 to 141) include the lines within which smoke detected signals from the smoke detectors on the various levels are monitored (starting with the lowest numbered fire zone and ending with the highest) and written into the “Activated Fire Zone” register (D0003).

These rungs come after rung 1 (relating broadly to the HMI overrides) and rung 2 (relating to the resetting of smoke detectors) but interrelate with those rungs (see below).

The relationship between the floor levels at Grenfell Tower and the fire zones used within the ladder logic is shown in the following table, extracted from PSB00000232:

LEVEL	Fire Zone
Ground floor	SDE01
	SDE25
Floor 01	SDE02
Floor 02	SDE03
	SDE26
Floor 03	SDE04
Floor 04	SDE05
Floor 05	SDE06
Floor 06	SDE07
Floor 07	SDE08
Floor 08	SDE09
Floor 09	SDE10
Floor 10	SDE11
Floor 11	SDE12
Floor 12	SDE13
Floor 13	SDE14
Floor 14	SDE15
Floor 15	SDE16
Floor 16	SDE17
Floor 17	SDE18
Floor 18	SDE19
Floor 19	SDE20
Floor 20	SDE21
Floor 21	SDE22
Floor 22	SDE23
Floor 23	SDE24
	ENVIRONMENTAL

As an example, line 86 is the fire detection line relating to zone 8, which was Level 7 at Grenfell Tower as shown above:



Line 86 shows that if:

- the smoke detector at Level 7 detected smoke, activating the “fire detected zone 8” input (I3S46) (i.e. the third input on slave 46);<sup>2</sup> and
- the “firemans override from HMI activated internal relay” (M0160) was not activated;<sup>3</sup> and
- the “Activated Fire Zone” register (D0003) value was set at “0” (because no other smoke detected signal had been written into the “Activated Fire Zone” register since it was last reset – the default value for D0003 was “0” in standby mode),

then the value “8” would be inputted into the “Activated Fire Zone” register (D0003), to signify that fire zone 8 (Level 7) had been activated.

Line 86 (and other fire detection rungs) – related lines



Line 13: shows that the “FIRE detected all zones” relay (M0006) was activated where the value of the data in the “Activated Fire Zone” register (D0003) had been set equal to or greater than “1” (following a “Fire Reset Delay” of 1 second)

<sup>2</sup> Note that some of the relays / inputs were “normally open” whereas some were “normally closed”, meaning that activating these relays / inputs would in some cases cause them to open and in some cases cause them to close. This explanation therefore uses the language of activation rather than opening / closing for clarity and consistency.

<sup>3</sup> Which would be the case unless (1) the “FIRE detected all zones” relay (M0006) had already been activated by a smoke detected signal (see line 13 below) and (2) the “HMI FOS4” input (I0003) was activated due to the HMI FOS having already been switched to “on” (see line 1 below)



*Line 1: shows that the “firemans override from HMI activated internal relay” (M0160) would only be activated if the “FIRE detected all zones” relay (M0006) had been activated (see line 13 above) and the “HMI FOS4” input (I0003) was activated due to the HMI FOS having been switched to “on”*

#### Line 11 - “Activated Fire Zone” register (D0003) and “Fire Zone Status” register (D0002)

Line 11 is the line by which the data written into the “Activated Fire Zone” register (D0003) (see above regarding line 86) is copied over into the “Fire Zone Status” register (D0002) (pending any activation of the System’s override controls).

The value inputted within register D0003 is used to direct the system to operate in smoke control mode (via the M0006 relay – see line 13 above) and the value within register D0002 is then used elsewhere within the ladder to tell the fans and dampers in what manner to operate (i.e. what speed the fans should run at and upon what floor levels dampers should open and close).

Line 11 is as follows:



Line 11 shows that if:

- the “firemans override from HMI activated internal relay” (M0160) was not activated;<sup>4</sup> and

<sup>4</sup> Which would be the case unless (1) the “FIRE detected all zones” relay (M0006) had already been activated by a smoke detected signal (see line 13 above) and (2) the “HMI FOS4” relay (I0003) was activated due to the HMI FOS having already been switched to “on” (see line 1 above)



- following a “Fire Zone Update Delay” of 1 second, the “de-activate everything internal relay” (M0163) was not activated (due to the Turn System Off button not having been successfully selected from the HMI panel (see line 3 below)),

then the value inputted into the “Activated Fire Zone” register (D0003) would be copied into the “Fire Zone Status” register (D0002).

#### Line 11 – related lines



*Line 3: shows that the “de-activate everything internal relay” (M0163) would be activated when the “de-activate everything from key switches on floors” relay (M0165) was not activated (which was always the case for this System) and, following a “Fire Reactivation Timer” delay of 1 second, the “firemans override from HMI activated internal relay” (M0160) had been activated (see line 1 above) and the “activate everything pushbutton from HMI” relay (M0162) was not activated (due to the “Restart System” button not having been pressed from the HMI panel) and the “de-activate everything pushbutton from HMI” relay (M0161) was activated (due to the “Turn System Off” button having been pressed from the HMI panel)*

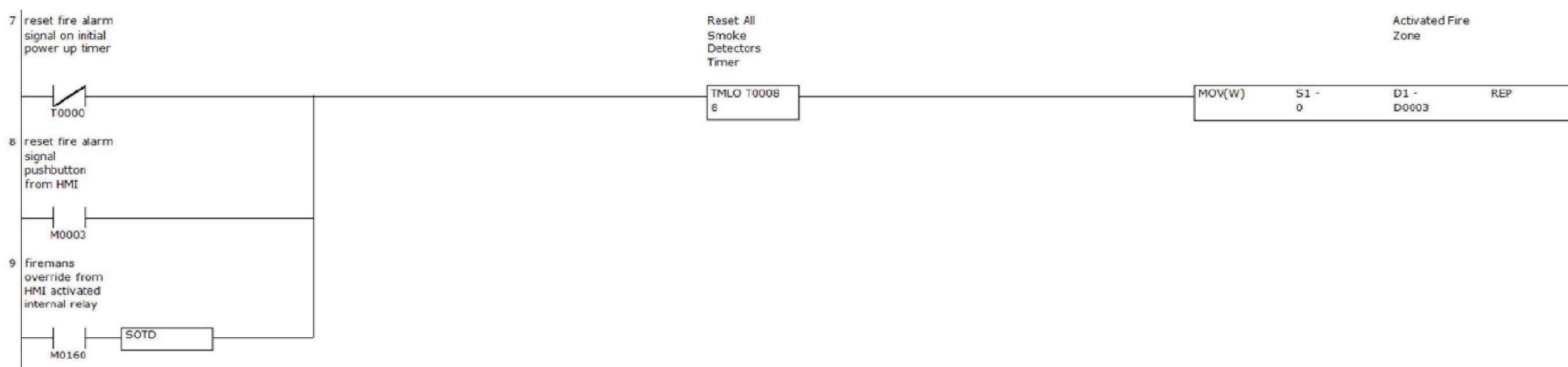
#### Lines 7 to 9 – resetting the System

Lines 7 to 9 set the conditions leading to the resetting of the smoke detectors and the “Activated Fire Zone” register (D0003).

As per the above, the value inputted within register D0003 was used to direct the system to operate in smoke control mode (via the M0006 relay) and the value inputted within register D0002 (which would be copied from register D0003 pending any activation of the System’s override controls) was then used elsewhere within the ladder to tell the fans and dampers in what manner to operate (i.e. what speed the fans should run at and upon what floor levels dampers should open and close).

As such, resetting the value within the “Activated Fire Zone” register (D0003) to “0” in this manner would return the System to standby mode (i.e. with all fans being switched off and all dampers closed) pending any further smoke detection signal via the fire detection rungs (including line 86) as explained above (or any activation of the System in environmental mode). As explained above, smoke detected signals from the smoke detectors on the various levels would be monitored as before starting with the lowest numbered fire zone and ending with the highest.

Lines 7 to 9 are as follows:



Lines 7 to 9 show that if:

- the “reset fire alarm signal on initial power up timer” relay (T0000) was not active (due to the System having been powered up within the last 2 seconds); or
- the “reset fire alarm signal pushbutton from HMI” relay (M0003) was activated (due to the “Reset Fire Signal” button having been selected from the HMI panel); or
- the “firemans override from HMI activated internal relay” (M0160) was deactivated having previously been active (due to the HMI FOS being turned from “on” to “auto” after the “FIRE detected all zones” relay (M0006) had been activated (*see line 1 above*)),

then

- the “Reset All Smoke Detectors Timer” (T0008) signal would be activated for 8 seconds (turning off the power to all smoke detectors for that period (*see line 38 below*) before power to the smoke detectors was restored); and
- the value within the “Activated Fire Zone” register (D0003) would be reset to “0” for a period of 8 seconds.



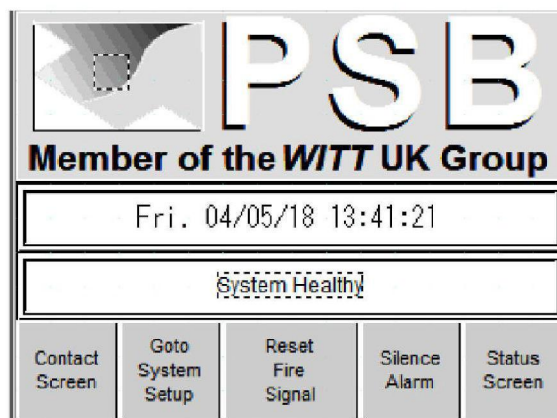
Lines 7 to 9 – Related Lines



*Line 38: shows that the relays (Q1S1 to Q2S33 – Q1S1 shown above by way of example) to power off the smoke detectors (SDE1 to SDE26) were activated while the “Reset All Smoke Detectors Timer” relay (T0008) was activated (see line 7 above)*

### “Reset Fire Signal” Button

The System could also be reset by selecting the “Reset Fire Signal” button from the HMI touch screen main home page (which would be the default page displayed upon activation of the HMI touch screen, except where a smoke detector activated signal had been received and the HMI FOS had been switched to “on”):



Selecting this “Reset Fire Signal” button would cause the System to operate in exactly the same manner as where the HMI FOS was switched from “on” back to “auto” while the System was operating in smoke control mode as described above (see lines 7 to 9 of the ladder logic as above).

In other words, selecting this button would reset the System such that it would have been instructed to await a new smoke detection signal and would then have operated on the floor from which a smoke detected signal was first received following the reset.

As such, had the “Reset Fire Signal” button been selected in the fire scenario described by Dr Lane, any of the levels with smoke present (any of Levels 4 to 9 in Dr Lane’s example) could then have been the first to be activated in smoke control mode.

It is noted that Dr Lane appears to agree that this is the case (at BLAS0000031\_0095):

*13. My team’s analysis of the programming shows that while in Auto, if the ‘Reset Fire Signal’ button on the HMI menu first screen is pressed, and there is still smoke present to activate a smoke detector in one or more of the lobbies, then the system will restart on the floor from which a signal from a smoke detector is first received, regardless of the floor of original operation.*

While RINA Tech do not address the operation of the System in this scenario in detail, they do appear to also acknowledge that the System could be reset from the HMI panel (at MET00072161\_0022):

*Removing the smoke detected signal had no effect unless the system was reset from the HMI.*