

5. CBS Alarms

5.1. Responding to a CBS Alarm

The CBS uses its alarm contacts to signal the presence of alarm conditions. There are two alarm relays: one for “Caution” alarms and one for “Problem” alarms. Each relay has two sets of three contacts, each set having a common, a normally closed (NC) and a normally open (NO) contact. There is continuity between the NO contact and the common contact if the pick-up coil of the relay is energized. Depending on the configured type of alarm logic, the CBS will pick up a relay to signal either an alarm condition or the absence of an alarm condition.

Responding to a CBS alarm involves the following steps:

- 1) Understanding the alarm condition
- 2) Taking corrective action
- 3) Acknowledging the alarm condition and/or making changes to settings

Table 5.1 can be used by itself as a guide to alarm resolution. Simply find the issue in the left column and follow the instructions on the right.

5.2. Understanding the Alarm Condition

Table 5.1 has detailed instructions that will help the user gain an understanding of an alarm condition. Oftentimes the only symptom observed by the user is a CBS alarm. The CBS is designed to be interrogated remotely via two-way communication, allowing access to all data and settings. However, if qualified personnel are on site, the “Detailed Condition” lights on the CBS front panel (Table 5.1 Group 3) do offer basic information about the alarm, and some basic checks are immediately advised. Next, data must be downloaded using the “Data Download Wizard” of **CB Insight™**. The “Conditions” tab in *CB Insight™* gives further information about the nature of the alarm.

There are two types of issues:

- 1) **Conditions in alarm**, which indicate breaker problems; these are discussed in Table 5.1 Group 4.
- 2) **Corrupted conditions**, which are caused by installation or sensor problems; these are discussed in Table 5.1 Group 5.

Furthermore, questionable sensors or inputs that lead to corrupted conditions are investigated using the information provided by the Sensor Data Window (**Section 3.2.6**), as discussed in Table 5.1 Group 6.

Understanding the alarm condition also involves analyzing raw data as described in Table 5.2. It is one of the design principles of the CBS that every decision to alarm is backed up by raw data. This allows the user to determine the validity of the alarm before more time-consuming steps are taken.

5.3. Taking Corrective Action

Once the validity of an alarm is confirmed, corrective action must be taken. This may involve the following actions:

- Replacing a defective control coil
- Investigating breaker timing problems using an off-line timer
- Inspecting/replacing an interrupter
- Locating and stopping SF6 gas leaks
- Replacing defective heaters
- Adjusting or replacing thermostats
- Replacing blown fuses
- Replacing hydraulic valves
- Replacing motors

A detailed discussion of these actions is, of course, beyond the scope of this instruction book.

5.4. Settings Changes and Alarm Acknowledgement

Alarms can be acknowledged by right-clicking on the value in alarm (in the Conditions window) and selecting “Acknowledge” from the pop-up menu. Notice that acknowledging alarms only clears the alarm until the monitored value is recalculated and again in violation of the alarm limits. For conditions that are recalculated constantly, the alarm is reissued immediately. For conditions that are only calculated when the breaker operates, the alarm may come back at that time.

To permanently clear an alarm, either the physical problem must be corrected (see **Section 5.2** “*Understanding the Alarm Condition*”) or the settings must be changed.

Notice that the user is responsible for managing the CBS settings even if they were initially defined by the factory and/or by following the commissioning procedure.

Example: The CBS alarms on a slow closing speed of 3.4 m/s. To clear the alarm the user sets the “Expected Minimum” to 3.4 m/s. With the “Caution Margin” being 0.5 m/s the CBS will not alarm again until the closing speed drops below to 2.9 m/s. At this point it is confirmed that the breaker continuously slows down – a physical problem that needs to be investigated and resolved.







Table 5.1 – Alarm Resolution	
Symptom	Action
Group 1 – Alarm Contacts	
Alarm contacts closed	Check Detailed Condition Lights. Go to Group 3
Group 2 – Overall Conditions Lights	
“Problem” or “Caution” light on	Check Detailed Condition Lights. Go to Group 3
Group 3 – Detailed Condition Lights	
 SF6 Gas	Check SF6 pressure gauge and SF6 pressure sensor cable. Using CB Insight™, download the “Conditions” and go to Group 4
 Mechanism	Check travel sensor cable. Using CB Insight™, download the “Conditions” and go to Group 4.
 Interrupter	Using CB Insight™, download the “Conditions” and go to Group 4.
 Charging System	Check motor counters. Using CB Insight™, download the “Conditions” and go to Group 4.
 Control Coils	Check coil continuity and CBS coil connections. Using CB Insight™, download the “Conditions” and go to Group 4.
 Heaters	Verify heaters are on or off as they should be at the present temperature. Using CB Insight™, download the “Conditions” and go to Group 4.
All off	Unless the “Normal” light is on, download the “Conditions” using CB Insight™ and go to Group 4





Table 5.1 – Alarm Resolution (continued)	
Symptom	Action
Group 4 – Conditions in Alarm	
 Integrity	Go to Group 5.
 C.Coil Monitor	<p>If assessment is “Open”: Verify that a close coil is intended to be monitored; if not - disable the condition. If close coil is intended to be monitored, verify coil connections at J6 pos 1 and 2. Verify that connection to coil is not blocked by a series auxiliary switch. Check continuity using ohm-meter and replace coil if defective.</p> <p>If assessment is “Shorted”: Verify that connections at J6 pos 1 and 2 are not accidentally shorted. Verify that the inductance of the coil to be monitored fits the range listed in Table 2.2. Right-click on value and select “Edit Limits”. If value is only slightly out of range adjust “Expected Minimum” and click “OK”. Otherwise, check coil continuity using ohm-meter and replace coil if defective.</p>
 Pri.TC.Monitor	<p>If assessment is “Open”: Verify that a trip coil is intended to be monitored; if not - disable the condition. If close coil is intended to be monitored, verify coil connections at J6 pos 3 and 4. Check continuity using ohm-meter and replace coil if defective.</p> <p>If assessment is “Shorted”: Verify that connections at J6 pos 3 and 4 are not accidentally shorted. Verify that the inductance of the coil to be monitored fits the range listed in Table 2.2. Right-click on value and select “Edit Limits”. If value is only slightly out of range adjust “Expected Minimum” and click “OK”. Otherwise, check coil continuity using ohm-meter and replace coil if defective.</p>
 Sec.TC.Monitor	<p>If assessment is “Open”: Verify that a trip coil is intended to be monitored; if not - disable the condition. If close coil is intended to be monitored, verify coil connections at J6 pos 5 and 6. Check continuity using ohm-meter and replace coil if defective.</p> <p>If assessment is “Shorted”: Verify that connections at J6 pos 5 and 6 are not accidentally shorted. Verify that the inductance of the coil to be monitored fits the range listed in Table 2.2. Right-click on value and select “Edit Limits”. If value is only slightly out of range adjust “Expected Minimum” and click “OK”. Otherwise, check coil continuity using ohm-meter and replace coil if defective.</p>
























Table 5.1 – Alarm Resolution (continued)	
Symptom	Action
Group 4 – Conditions in Alarm	
 Travel (Close)	Right-click and select “Acknowledge”. Verify travel curve according to Table 5.2. If validity is confirmed, right-click on the monitored value and select “Edit Limits”; if the value is only slightly outside the “Expected Range”, adjust the “Expected Minimum” or “Expected Maximum” to include the value. Otherwise check travel measurement using standard breaker timer.
 Travel (Open)	
 Travel (C/O)	
 Closing Speed	Same, except check speed using standard breaker timer.
 Opening Speed	
 Open.Speed(C/O)	
 React.Time(C)	Same, except check reaction time using standard breaker timer.
 React.Time(O)	
 Mech.Time(C)	Same, except check mechanical closing/opening time using standard breaker timer.
 Mech.Time(O)	
 Close Coil Time	Right-click and select “Acknowledge”. Verify coil energization trace according to Table 5.2. If validity is confirmed, right-click on the monitored value and select “Edit Limits”; if the value is only slightly outside the “Expected Range”, adjust the “Expected Minimum” or “Expected Maximum” to include the value. Otherwise check coil time using standard breaker timer.
 Pri. T.C. Time	
 Sec. T.C. Time	
 Contact Wear(1)	Check current channel 1 connections at J5 pos 1 and 2 per <i>Section 2.6</i> . Double-check if current channel is to be used. If not, disable condition and make sure the input is shorted out. If ring-core CTs are used, verify that external burden resistor is installed correctly. Verify the “Current Resolution” setting per <i>Section 2.18</i> . Verify current trace 1 per table 5.2. If excessive wear is plausible, check interrupter. If interrupter is replaced, reset all three wear values to zero. If interrupter is somewhat worn or in as-new condition, contact ABB.
 Aux Noz.Wear(1)	
 Nozzle Wear(1)	
 Contact Wear(2)	Same except for current channel 2 and J5 pos 3 and 4 .
 Aux Noz.Wear(2)	
 Nozzle Wear(2)	
 Contact Wear(3)	Same except for current channel 2 and J5 pos 5 and 6 .
 Aux Noz.Wear(3)	
 Nozzle Wear(3)	
 Trip Count	This condition is informative only and should not cause an alarm unless the settings have been changed from their default. Reset the value or change the expected maximum to include the value.
















Table 5.1 – Alarm Resolution (continued)	
Symptom	Action
Group 4 – Conditions in Alarm	
 RMS Current(1)	Check current channel 1 connections at J5 pos 1 and 2 per <i>Section 2.6</i> . Double-check if current channel is to be used. If not, disable condition and make sure the input is shorted out. If ring-core CTs are used, verify that external burden resistor is installed correctly. Verify the “Current Resolution” setting per <i>Section 2.18</i> . Verify current trace 1 per table 5.2 This condition is informative only and should not cause an alarm unless the settings have been changed from their default.
 RMS Current(2)	Same except for current channel 2 and J5 pos 3 and 4 .
 RMS Current(3)	Same except for current channel 2 and J5 pos 5 and 6 .
 Tank/Gas Temp.	Low temperature alarms are indicative of heater failures. Follow the instructions for heater alarms 8 rows below.
 Mech./Cab. Temp.	Low temperature alarms are indicative of heater failures. Follow the instructions for heater alarms 7 rows below.
 Comp. SF6 Pres.	Compare value with the value reported by a temperature corrected gauge. If there is a significant deviation, check SF6 pressure input per Group 6. If pressure readings are in agreement, right-click on the value and select “Edit Limits”. Correct either the “Caution” or “Problem” margin to clear the alarm.
 Leak Rate (1)	Use hand-held SF6 leak detector to identify location of leak. The alarm will clear automatically once temperature compensated pressure remains unchanged.
 Leak Rate (2)	
 Leak Rate (3)	Verify raw data per Table 5.2. If alarm is caused by fluctuations, right-click on the value, select “Edit Limits” and increase the “Caution Margin”. Otherwise use hand-held SF6 leak detector to identify location of leak or call ABB for leak detection services.
 Leak Rate (4)	Verify raw data per Table 5.2. Call ABB for leak detection services.
 Leak Rate (5)	
 H1 Off At Low Temp.	Check heater CT connections at J8 pos 8 and 11 . If no heater is to be monitored, disable the condition. Otherwise verify the High/Low settings of the tank temperature input via the Sensor Data windows. Verify that the tank temperature input at J8 pos 1 and 3 is not shorted. Check the setting of the tank temperature thermostat. Check continuity of the heater.
 H1 On At High Temp.	Verify the High/Low settings of the tank temperature input via the Sensor Data windows. Verify the tank temperature probe connections at J8 pos 1 and 3 . Check the setting of the tank temperature thermostat.
 H2 Off At Low Temp.	Check heater CT connections at J8 pos 9 and 11 . If no heater is to be monitored, disable the condition. Otherwise verify the High/Low settings of the tank temperature input via the Sensor Data windows. Verify that the tank temperature input at J8 pos 1 and 3 is not shorted. Check the setting of the tank temperature thermostat. Check continuity of the heater.
 H2 On At High Temp.	Verify the High/Low settings of the tank temperature input via the Sensor Data windows. Verify the tank temperature probe connections at J8 pos 1 and 3 . Check the setting of the tank temperature thermostat.











Table 5.1 – Alarm Resolution (continued)	
Symptom	Action
Group 4 – Conditions in Alarm	
 H3 Off At Low Temp.	Check heater CT connections at J8 pos 9 and 11 . If no heater is to be monitored, disable the condition. Otherwise verify the High/Low settings of the tank temperature input via the Sensor Data windows. Verify that the tank temperature input at J8 pos 1 and 3 is not shorted. Check the setting of the tank temperature thermostat. Check continuity of the heater.
 H3 On At High Temp.	Verify the High/Low settings of the tank temperature input via the Sensor Data windows. Verify the tank temperature probe connections at J8 pos 1 and 3 . Check the setting of the tank temperature thermostat.
 H4 Off	Check heater CT connections at J8 pos 12 and 16 . If no heater is to be monitored, disable the condition. Check continuity of the heater.
 H5 Off At Low Temp.	Check heater CT connections at J8 pos 13 and 16 . If no heater is to be monitored, disable the condition. Otherwise verify the High/Low settings of the tank temperature input via the Sensor Data windows. Verify that the mech./cab. temperature input at J8 pos 2 and 3 is not shorted. Check the setting of the mech./cab. temperature thermostat. Check continuity of the heater.
 H5 On At High Temp.	Verify the High/Low settings of the mech./cab. temperature input via the Sensor Data windows. Verify the tank temperature probe connections at J8 pos 2 and 3 . Check the setting of the tank temperature thermostat.
 H6 Off	Check heater CT connections at J8 pos 14 and 16 . If no heater is to be monitored, disable the condition. Check continuity of the heater.
 H7 Off At Low Temp.	Check heater CT connections at J8 pos 15 and 16 . If no heater is to be monitored, disable the condition. Otherwise verify the High/Low settings of the tank temperature input via the Sensor Data windows. Verify that the mech./cab. temperature input at J8 pos 2 and 3 is not shorted. Check the setting of the mech./cab. temperature thermostat. Check continuity of the heater.
 H7 On At High Temp.	Verify the High/Low settings of the mech./cab. temperature input via the Sensor Data windows. Verify the tank temperature probe connections at J8 pos 2 and 3 . Check the setting of the tank temperature thermostat.
 Motor Starts	If due to excessive run time, remove breaker from service and investigate.
 Motor Starts w/o Operation	If due to excessive run time, remove breaker from service and investigate. If due to excessive number of motor starts, service mechanism at earliest possibility.

Table 5.1 – Alarm Resolution (continued)	
Symptom	Action
Group 5 – Corrupted Conditions	
⚠ Travel (Close)	If travel sensor is installed, go to Group 6 and check “Contact Travel”. Otherwise disable corrupted conditions.
⚠ Travel (Open)	
⚠ Travel (C/O)	
⚠ Closing Speed	
⚠ Opening Speed	
⚠ Open.Speed(C/O)	
⚠ React.Time(C)	
⚠ React.Time(O)	
⚠ Mech.Time(C)	
⚠ Mech.Time(O)	
⚠ Close Coil Time	Go to Group 6 and check “Close C.Energ.”
⚠ Pri. T.C. Time	Go to Group 6 and check “Pri T.C..Energ.”
⚠ Sec. T.C. Time	Go to Group 6 and check “Sec T.C..Energ.”
⚠ Contact Wear(1)	If auxiliary CT for channel 1 and travel sensor are installed go to Group 6 and check “Contact Travel” and “Phase Current 1” Otherwise disable corrupted conditions.
⚠ Aux Noz.Wear(1)	
⚠ Nozzle Wear(1)	
⚠ Contact Wear(2)	If auxiliary CT for channel 2 and travel sensor are installed go to Group 6 and check “Contact Travel” and “Phase Current 2” Otherwise disable corrupted conditions.
⚠ Aux Noz.Wear(2)	
⚠ Nozzle Wear(2)	
⚠ Contact Wear(3)	If auxiliary CT for channel 3 and travel sensor are installed go to Group 6 and check “Contact Travel” and “Phase Current 3” Otherwise disable corrupted conditions.
⚠ Aux Noz.Wear(3)	
⚠ Nozzle Wear(3)	
⚠ RMS Current(1)	If auxiliary CT for channel 1 is installed, go to Group 6 and check “Phase Current 1”. Otherwise disable corrupted condition.
⚠ RMS Current(2)	If auxiliary CT for channel 2 is installed, go to Group 6 and check “Phase Current 2”. Otherwise disable corrupted condition.
⚠ RMS Current(3)	If auxiliary CT for channel 3 is installed, go to Group 6 and check “Phase Current 3”. Otherwise disable corrupted condition.
⚠ Tank/Gas Temp.	If tank temperature probe is installed, go to Group 6 and check “Tank/ Gas Temp.”. Otherwise disable corrupted condition.
⚠ Mech./Cab. Temp.	If mechanism or cabinet temperature probe is installed, go to Group 6 and check “Mech./Cab. Temp.”. Otherwise disable corrupted condition
⚠ Comp. SF6 Pres.	If SF6 pressure sensor and tank temperature probe are installed, go to Group 6 and check “SF6 Pressure” and “Tank/Gas Temp.”. Otherwise disable corrupted conditions.
⚠ Leak Rate (1)	
⚠ Leak Rate (2)	
⚠ Leak Rate (3)	
⚠ Leak Rate (4)	
⚠ Leak Rate (5)	

Table 5.1 – Alarm Resolution (continued)	
Symptom	Action
Group 6 – Questionable Sensors / Inputs	
🔍 Tank/Gas Temp.	Check RTD connections at J8 pos 1 and 3
🔍 Mech/Cab Temp.	Check RTD connections at J8 pos 2 and 3
🔍 SF6 Pressure	Check pressure sensor cable connections. Check offset and multiplier settings. Verify sensor is not clogged with thread lock etc. Replace sensor as last resort.
🔍 Phase Current 1	Check CT connections at J5 pos 1 and 2.
🔍 Phase Current 2	Check CT connections at J5 pos 3 and 4. Unused inputs must be shorted using a wire jumper.
🔍 Phase Current 3	Check CT connections at J5 pos 5 and 6. Unused inputs must be shorted using a wire jumper.
🔍 Contact Travel	Check travel sensor cable connection at J7. Check cable connection on travel sensor side. Travel sensor must be mounted securely. Replace sensor as last resort.
🔍 A-Switch	Check A-switch wiring at J6 pos 9 and 10. Clean A-switch.
🔍 B-Switch	Check B-switch wiring at J6 pos 10 and 11. Clean B-switch.

Table 5.2 – Raw Data Verification

Data Type	Action
Close Coil Energization Trace	Verify that the trace is continuous and not intermittent. Intermittent coil energization traces are a sign that the battery voltage drops below 95V (on 125V and 250V systems) or below 40V (on 48V systems) and should be corrected by increasing the number of conductors or conductor gauges used to connect the breaker cabinet to the station battery. If coil energization is unrealistically short, check the polarity of the connections at J6 pos 1 and 2 .
Pri. Trip Coil Energization Trace	Same except for J6 pos 3 and 4 .
Sec. Trip Coil Energization Trace	Same except for J6 pos 5 and 6 .
A-Switch Trace	Verify that the trace changes states exactly twice for a C/O operation and once for close and trip operations. Intermittent auxiliary switch traces are a sign of excessive contact bounce. If the trace does not change states at all, check the connections at J6 pos 9 and 10 .
B-Switch Trace	Same except for J6 pos 10 and 11 .
Travel Curve	Verify that trace is continuous and does not exhibit glitches or steps (other than those from lower resolution travel sensor installation). Verify that travel curve is not cut off at beginning or end. Overlay several travel curves of the same type to verify the repeatability of the contact travel measurement. If contact travel is flat, check the travel sensor cable connected at J7 at both ends. If contact travel is fluctuating up and down by one count, check individual connections of J7 pos 1 through 4 at both ends. Use markers to verify total travel, speed and timing values displayed on the Conditions tab.
Current Trace 1	Verify that current trace is sinusoidal, otherwise check connections at the input J5 pos 1 and 2 . Some noise is normal for load current magnitudes. If the trace is zero, verify that ring-core or split-core CTs are installed correctly per <i>Section 4.6</i> and <i>4.7</i> . If trace is flat and non-zero, check for loose connections at the input. If the input is not to be used but the trace is non-zero, make sure a wire jumper is installed across the input. If trace resembles a square wave and ring-core CTs are used, make sure that the external burden resistor is securely installed at the input.
Current Trace 2	Same except for J5 pos 3 and 4
Current Trace 3	Same except for J5 pos 5 and 6

Table 5.2.
Raw Data Verification (continued)

Data Type	Action
Heater H1 Current Trace	Display the heater current trace in all 5 (or all available) time spans. The trace covers a range of 0 to about 350 mA, whereas the latter is the cut-off current of the heater input. It indicates that the heater is fully on—carrying a current of several amps. The time spans covering minutes, hours, days and months are averages. Any intermediate value indicates that the heater was on part of the time of the averaging interval and off for the remainder. If the heater is on and its supply wire is routed through a heater CT and this heater CT is connected to J8 pos 8 and 11 , the trace should be around 350 mA. If not, check all links of the measurement chain: AC power, heater supply wire, heater CT, connections to the CBS. For a thermostat controlled heater, display the heater current traces in conjunction with the tank temperature . At temperatures warmer than the upper thermostat setting, the heater should be off. At temperatures colder than the lower thermostat setting, the heater should be on. In between the thermostat settings the heater may be on or off. For averages, this results in values between 0 and 350 mA.
Heater H2 Current Trace	Same except for J8 pos 9 and 11 .
Heater H3 Current Trace	Same except for J8 pos 10 and 11 .
Heater H4 Current Trace	Same except for J8 pos 12 and 16 and no temperature dependence.
Heater H5 Current Trace	Same except for J8 pos 13 and 16 and dependence on mechanism/cabinet temperature .
Heater H6 Current Trace	Same except for J8 pos 14 and 16 and no temperature dependence.
Heater H7 Current Trace	Same except for J8 pos 15 and 16 and dependence on mechanism/cabinet temperature .
Tank/Gas Temperature Trace	The temperature trace covers temperatures between -40° C and +100° C (-40° F to 212° F). If the temperature probe is not connected or poorly connected, the samples will be shown using crosses instead of a continuous line. See also “Missing Data Indicators” in <i>Section 2.12</i> “Input Pre-Processing”. First verify, using the connection diagram, that a temperature probe is intended to be connected. Then check the connections of the temperature probe at J8 pos 1 and 3 .
Mech./Cab. Temperature Trace	Same except for J8 pos 2 and 3 .

Table 5.2.
Raw Data Verification (continued)

Data Type	Action
(Uncompensated) Pressure Trace	<p>The uncompensated pressure trace (labeled using the word “pressure”) covers a range of 0 to 150 psi. If the pressure sensor is not properly connected, the samples will be shown using crosses instead of a continuous line. See also “Missing Data Indicators” in <i>Section 2.12</i> “Input Pre-Processing”. First verify, using the connection diagram, that a temperature probe is intended to be connected. Then check the connections of the pressure plug at the bottom of the enclosure. For CMU to CBS upgrades, there is an actual pressure sensor instead of merely an electrical connector. If the pressure is zero, check the installation of the pressure sensor. In particular, remove thread lock from the locations, where it is not specifically indicated per ABB pressure sensor installation drawings.</p>
Temp. Comp. Pressure Trace	<p>If both uncompensated pressure and tank temperature are valid, the temperature compensated pressure trace is a continuous and mostly flat line close to the nominal fill pressure of the circuit breaker. For the hourly averages, the trace may oscillate up and down due to temperature gradients and density fluctuations through the day. A downward slope corroborates leak rate alarms displayed on the conditions page. When a downward slope is apparent, the leak is confirmed. If either the pressure sensor or the tank temperature probe are not properly connected, the samples will be shown using crosses instead of a continuous line. See also “Missing Data Indicators” in <i>Section 2.12</i> “Input Pre-Processing”.</p>

