Brief Title: HYPER MHGU Unwanted Valve Opening

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Initial Report and Containment

Initial Report:
The Mobile Hydrogen Generation Unit (MHGU) system experienced an unwanted valve opening for about two hours in late June of 2020. Initial reports indicate problems with the user interface as discussed in this report.

Step 1: Define

Unwanted Outcome	Unwanted valve opening occurred for ~2 hours
Date	Late June, 2020
Location(s)	HYPER Outdoor Test Facility
Similar Problems?	Unknown
Cost or other impacts	Required new hydrogen tank. Was not a safety issue in this case (MHGU is located outdoors)

Recommendations Requested? Yes, provide recommended improvements to help preclude recurrence.
Monitoring Plan Requested? Notify Jacob Leachman and Ian Richardson if this problem happens again.

Step 2: Strategize

Problem Type: Unplanned deviation (a specific, single event)
Risk: TBD – need to examine HAZOPs
Analysis Tool: Build a Cause Tree (CT)
Management Sponsor: Jacob Leachman
Diagnosing Unwanted Outcomes™ Facilitator: Lauren Reising
Engineering: Ian Richardson

Step 3: Study

This was conducted using the guidance in the Diagnosing Unwanted Outcomes™ manual chapters 5 and 6.

Build Logical Sentence Structure

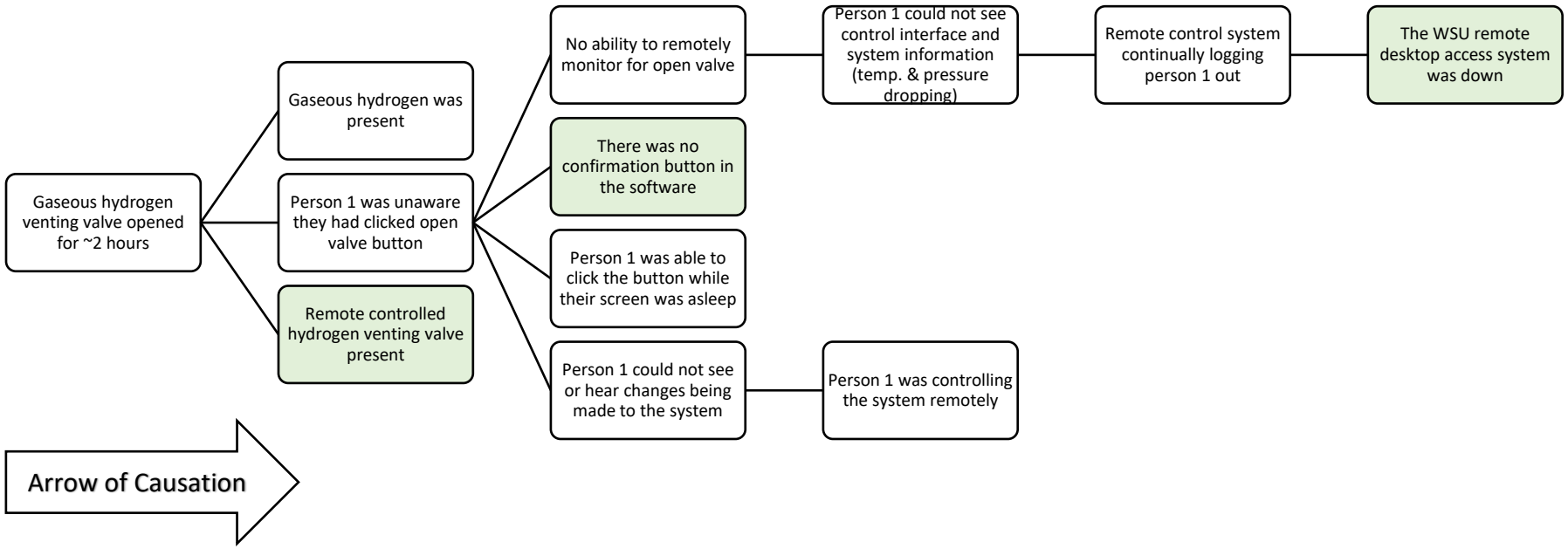
1. Gaseous hydrogen venting valve opened when it wasn't supposed to and gaseous hydrogen was present
2. Person 1 clicked open valve button on system control and they were unaware they had clicked open valve button
3. Computer appeared to be asleep, clicked to wake up computer, accidently clicked open valve button, software continually logging person 1 out, could not see changes being made to system (decreased pressure & temperature due to open valve venting gaseous hydrogen)
4. Person 1 was controlling the system remotely

Hierarchical List (H-List)

Gaseous hydrogen venting valve opened for ~2 hours

1. Gaseous hydrogen was present
2. Person 1 was unaware they had clicked open valve button
   - 2.1. No ability to remotely monitor for open valve
     - 2.1.1. Person 1 could not see control interface and system information (temp. & pressure dropping)
       - 2.1.1.1. Remote control system continually logging person 1 out
         - 2.1.1.1.1. The WSU remote desktop access system was down
   - 2.2. There was no confirmation button in the software
   - 2.3. Person 1 was able to click the button while their screen was asleep
   - 2.4. Person 1 could not see or hear changes being made to the system
     - 2.4.1. Person 1 was controlling the system remotely
3. Remote controlled hydrogen venting valve present

Cause Tree



Evidence for Causes

Identified causes were based on interviews of operators and SMEs along with system Plumbing and Instrumentation Diagrams (P&IDs).

Step 4: Provide Recommendations

Possible Solution Identification and Evaluation

Possible solutions were based on a review of the causes found (cause tree) and input/suggestions from operators and SMEs.

Recommended Solutions and Monitoring Plan

#	Cause	Possible Solution	Pass Eval?	Recommended?	Comments	Monitor?
1	Remote controlled hydrogen venting valve present	Changed to a manual (non-remote control) valve	Yes	Yes	Already implemented	No
2	There was no confirmation button in the software	Modified software to provide confirmation for all controls (see note below)	Yes	Yes		No
3	The WSU remote desktop access system was down	New remote access login for HYPER	Yes	Yes	Already implemented	No

Note for solution 2: While solution 1 removed the valve, solution 2 recognizes that similar issues could occur on other controls. In other words, solution 2 is not helping this unwanted outcome but it is helping to prevent similar unwanted outcomes on MHGU.

Step 5. Recommend a Monitoring Plan

The recommended monitoring plan was included in the previous section.

End of Diagnosing Unwanted Outcomes™ Report