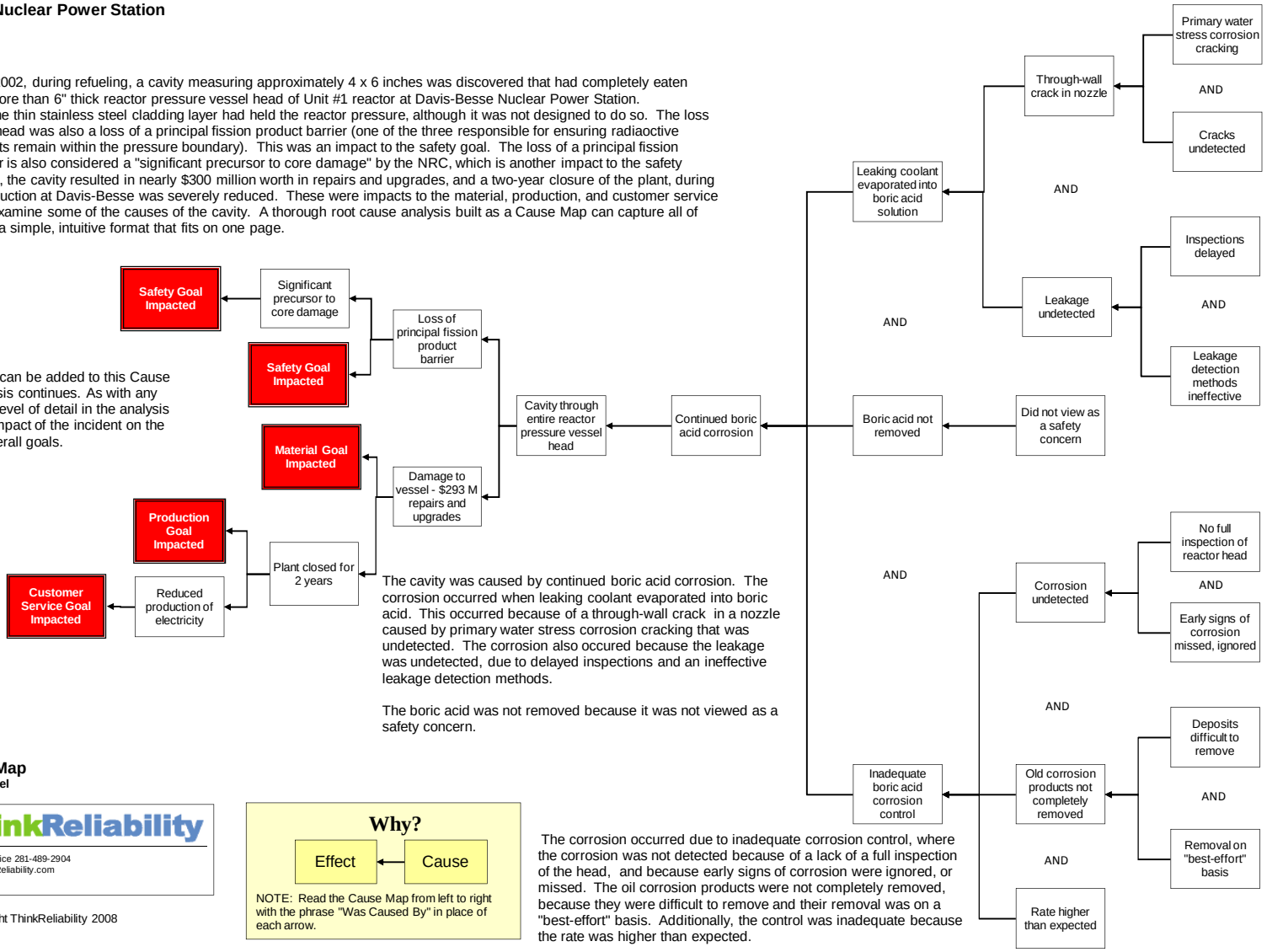
Reactor Vessel Head Degradation
Davis-Besse Nuclear Power Station
March 7, 2002

On March 7, 2002, during refueling, a cavity measuring approximately 4 x 6 inches was discovered that had completely eaten through the more than 6" thick reactor pressure vessel head of Unit #1 reactor at Davis-Besse Nuclear Power Station. Fortunately, the thin stainless steel cladding layer had held the reactor pressure, although it was not designed to do so. The loss of the vessel head was also a loss of a principal fission product barrier (one of the three responsible for ensuring radiaoctive fission products remain within the pressure boundary). This was an impact to the safety goal. The loss of a principal fission product barrier is also considered a "significant precursor to core damage" by the NRC, which is another impact to the safety goals. All told, the cavity resulted in nearly $300 million worth in repairs and upgrades, and a two-year closure of the plant, during electricty production at Davis-Besse was severely reduced. These were impacts to the material, production, and customer service goals. Let's examine some of the causes of the cavity. A thorough root cause analysis built as a Cause Map can capture all of the causes in a simple, intuitive format that fits on one page.



Even more detail can be added to this Cause Map as the analysis continues. As with any investigation the level of detail in the analysis is based on the impact of the incident on the organization's overall goals.

The cavity was caused by continued boric acid corrosion. The corrosion occurred when leaking coolant evaporated into boric acid. This occurred because of a through-wall crack in a nozzle caused by primary water stress corrosion cracking that was undetected. The corrosion also occured because the leakage was undetected, due to delayed inspections and an ineffective leakage detection methods.

The boric acid was not removed because it was not viewed as a safety concern.

The corrosion occurred due to inadequate corrosion control, where the corrosion was not detected because of a lack of a full inspection of the head, and because early signs of corrosion were ignored, or missed. The oil corrosion products were not completely removed, because they were difficult to remove and their removal was on a "best-effort" basis. Additionally, the control was inadequate because the rate was higher than expected.

Cause Map
Detail Level

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Why?

Effect ← Cause

NOTE: Read the Cause Map from left to right with the phrase "Was Caused By" in place of each arrow.