Risk Analysis of a Liquefied Natural Gas Storage Tank

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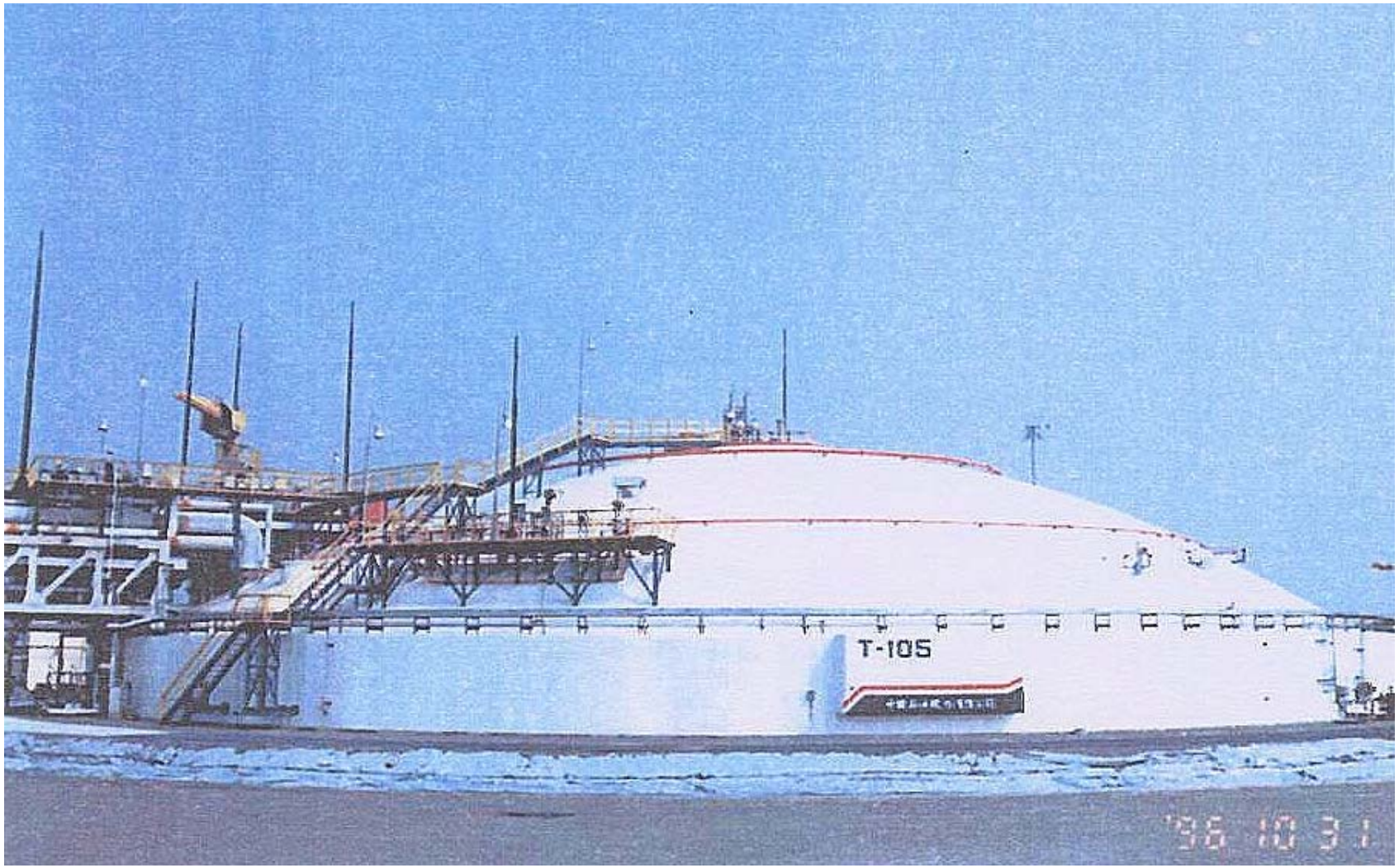
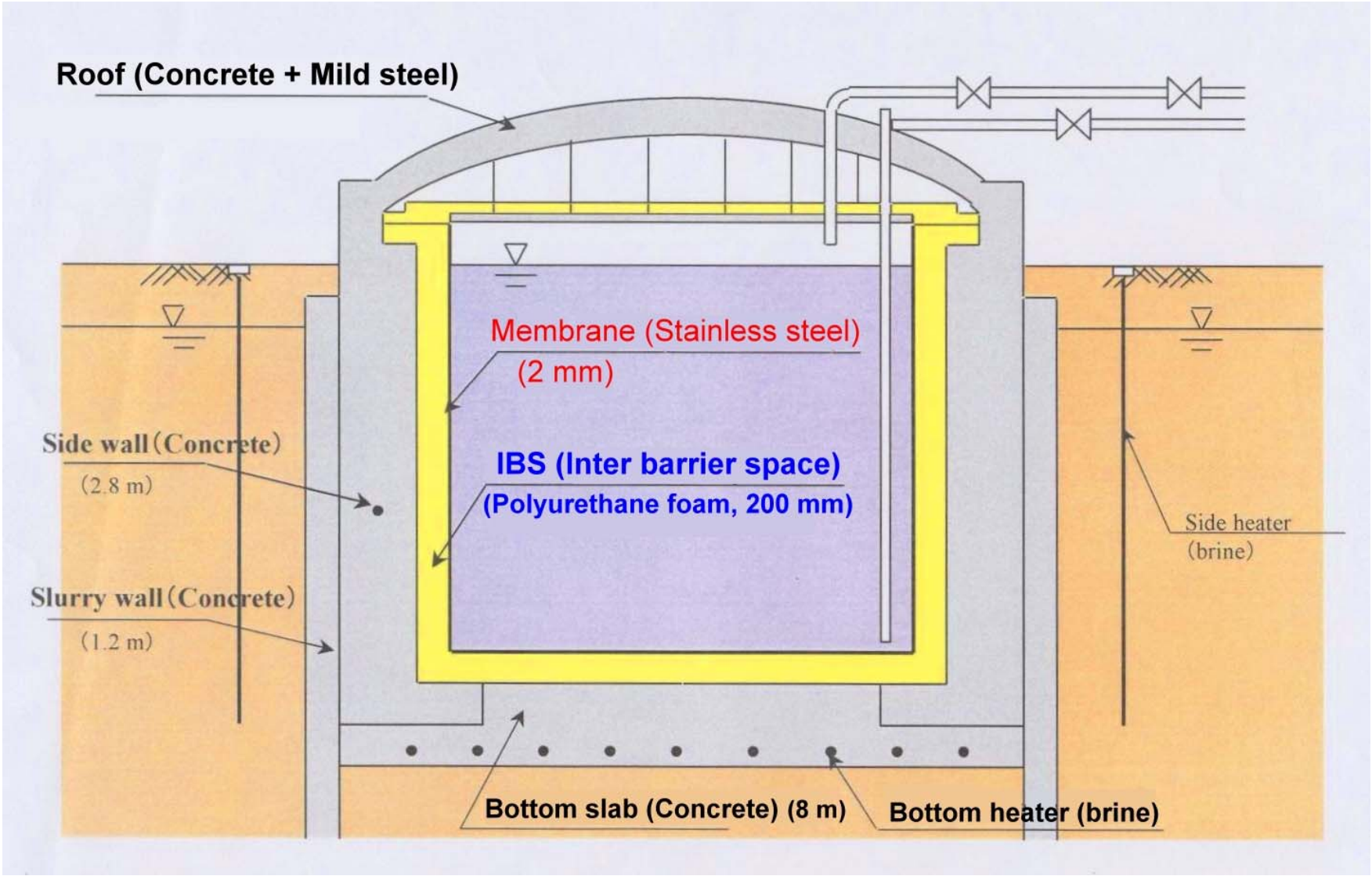
Outline

- 1. Introduction
- 2. Brief Description of INERFT
- 3. Results of Fault Tree Analysis
- 4. Conclusion

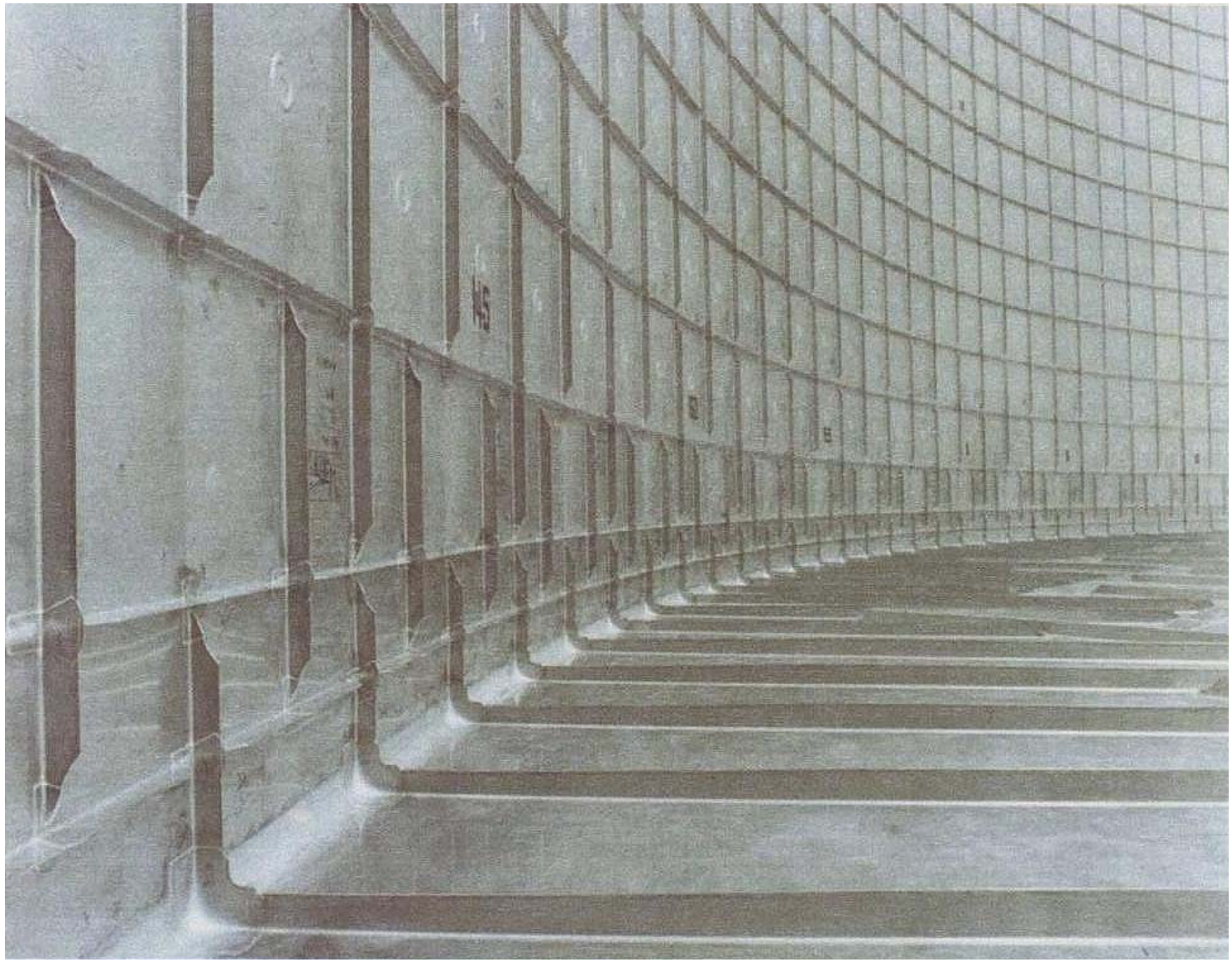
What’s the LNG tank?



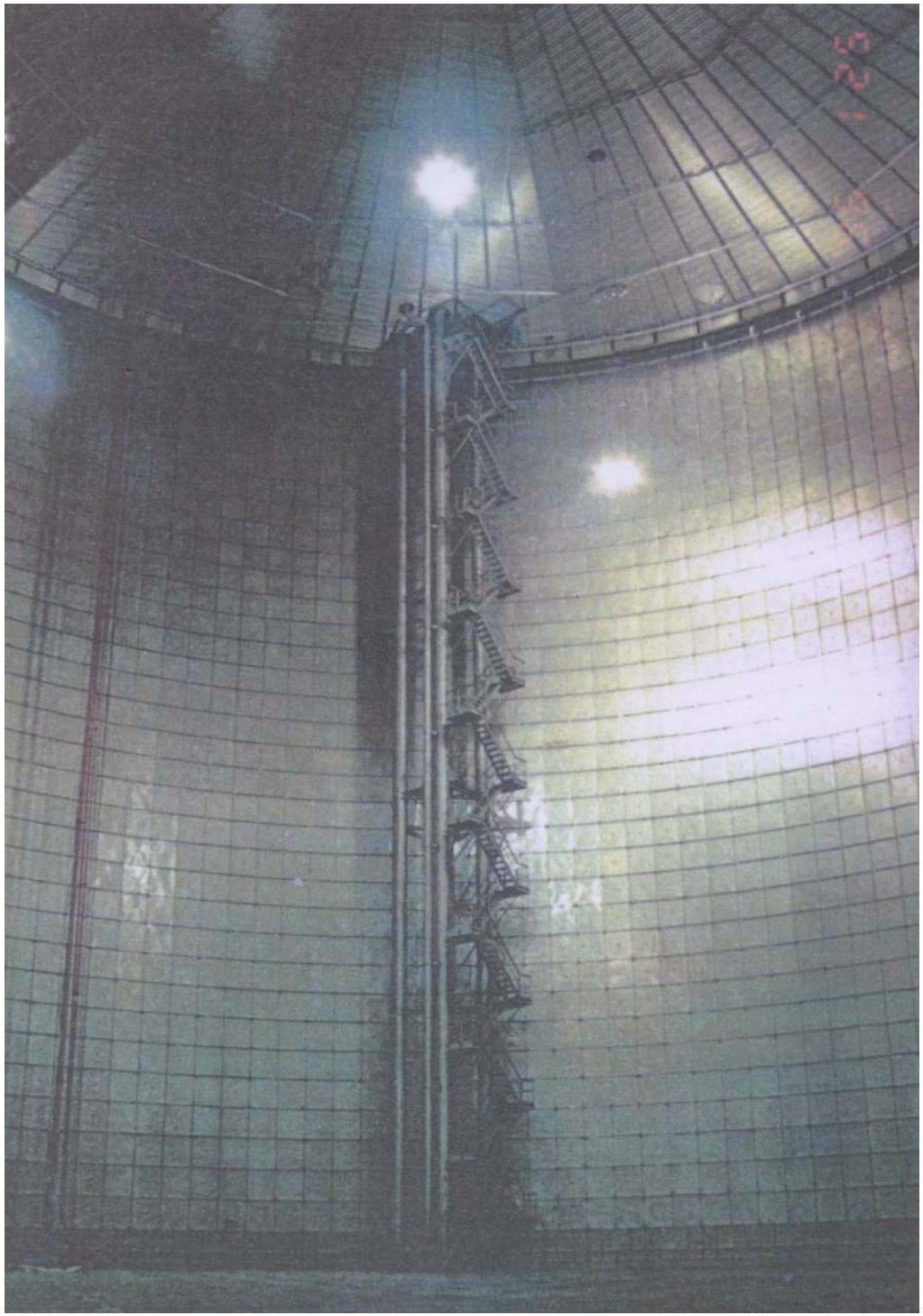
How does the LNG tank operate?



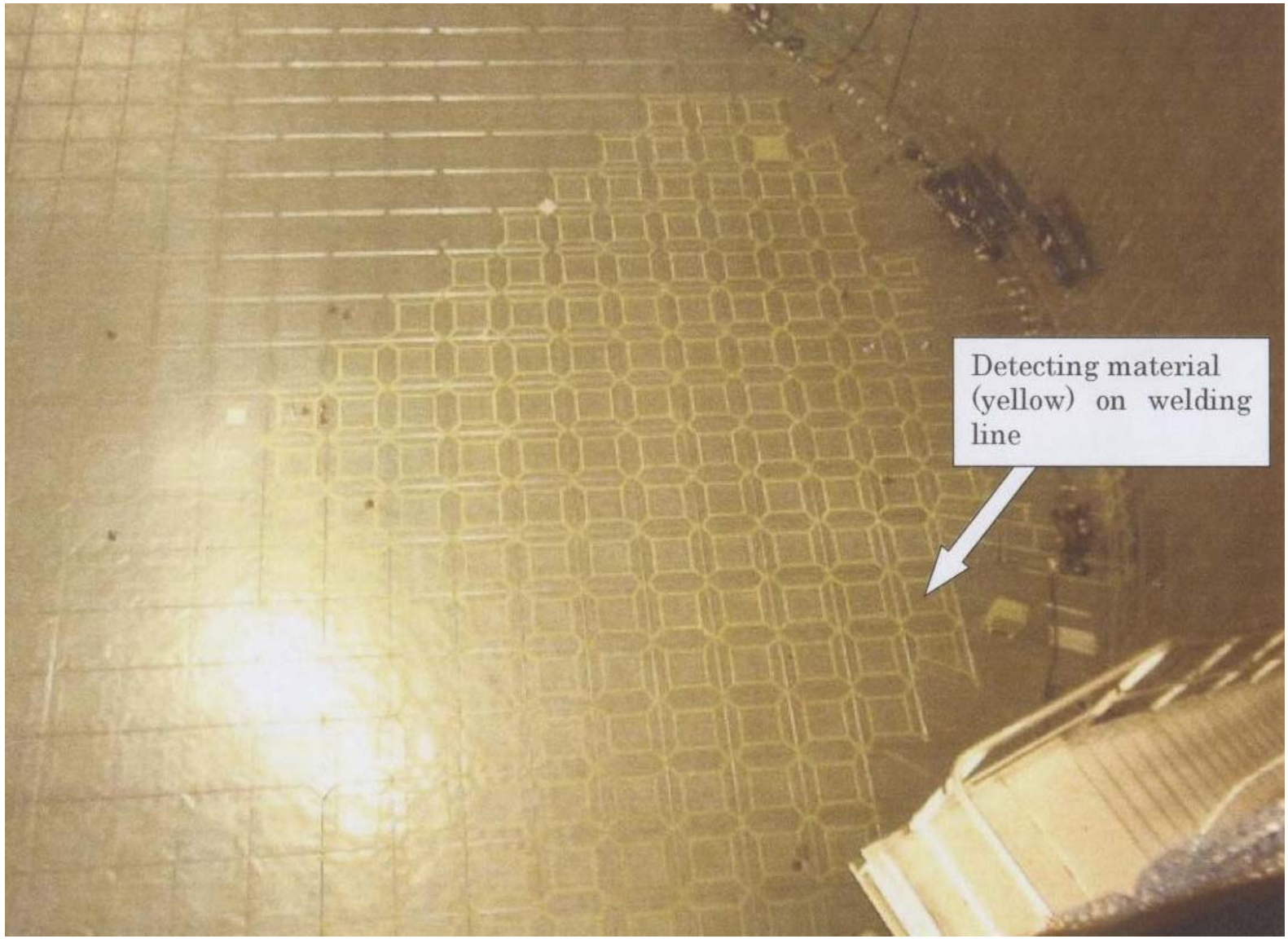
Inside view of LNG storage tank



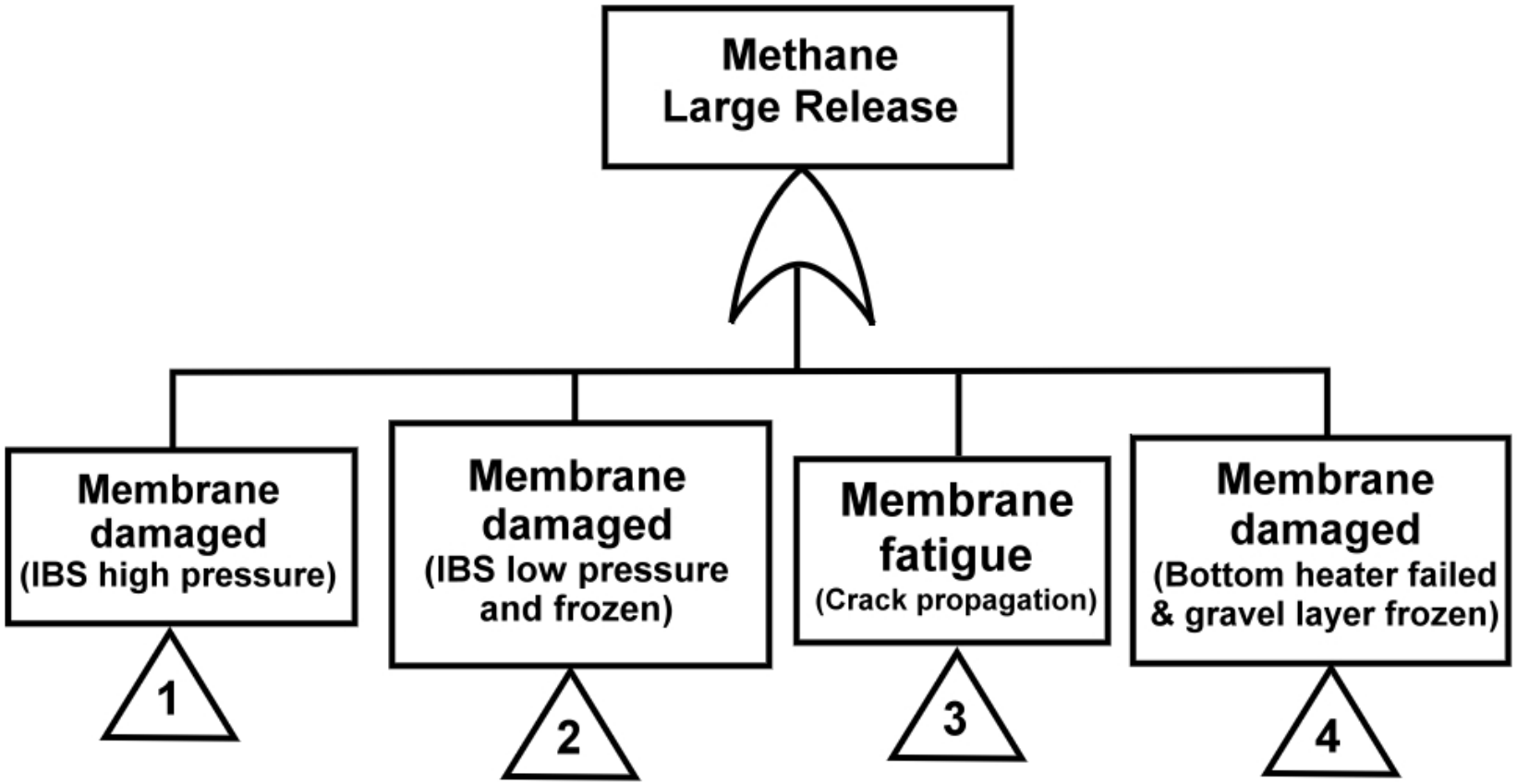
The In-ground LNG Tank



Ammonium test



Where is the risk from?



Quantification Tool

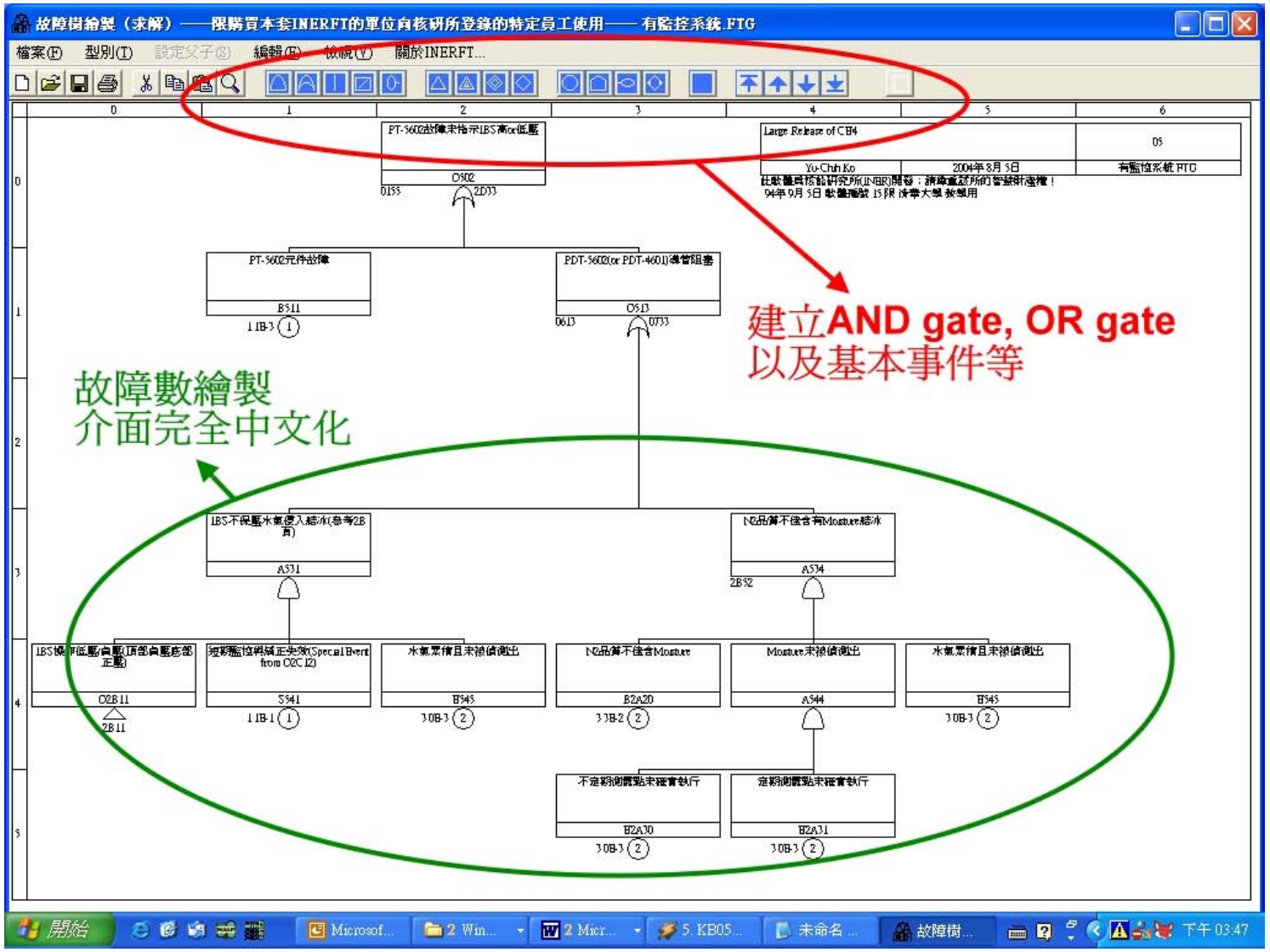
- **INERFT** (by INER, 2003)

=>A useful tool to solve FT and perform importance analysis

=>Handy, Friendly and High efficiency

=>Two versions, Chinese & English

The INERFT Interface



Minimum Cut Set

- Over 80% of the MCS comes from the second membrane failure mode.
- Major MCS are related to "Frozen line has not yet been established" .

⇒Membrane Damaged (IBS low pressure with water ingression) is the dominant failure mode.

Importance Ranking

- The most important human action

=>Operators fail to notice the accumulation of water vapor in the IBS over a long period of time.

- The most important non-human action

=>Frozen line has not yet been established.

Strategy

- “Frozen line has not yet been established” is a special event and has a given conservative probability of 1.0.

=>It is a physical phenomenon during the operation of in-ground storage tank.

=>Try to improve the human action by additional training and adding parallel devices

Sensitivity Studies

- Method 1. Adding a parallel pressure transmitter to reduce the signal error

=>reduce the probability of random signal error

- Method 2. Implementing an additional training for operators

=>improve the human action error when IBS low pressure occurs. (reduced by an order)

Results

	Top Event Probability	Decrease ratio
Base Case	3.04E-06	------
Method 1	2.25E-06	-25.0 %
Method 2	8.08E-07	-73.1 %
Both 1 & 2	6.63E-07	-77.9 %

Conclusion

- It can be expected that the risk of the in-ground tank will be lower after the frozen line is established.
- Decision making – an economic and effective way to reduce the risk

=>”Implementing an additional training for operators” maybe a good choice

Thank you for your attention!