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PGCF.1 Increasing asset value of LNG storage tank through Tokyo Gas computational fluid dynamics (CFD) simulation model for Mixed LNG Storage Technology

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Background

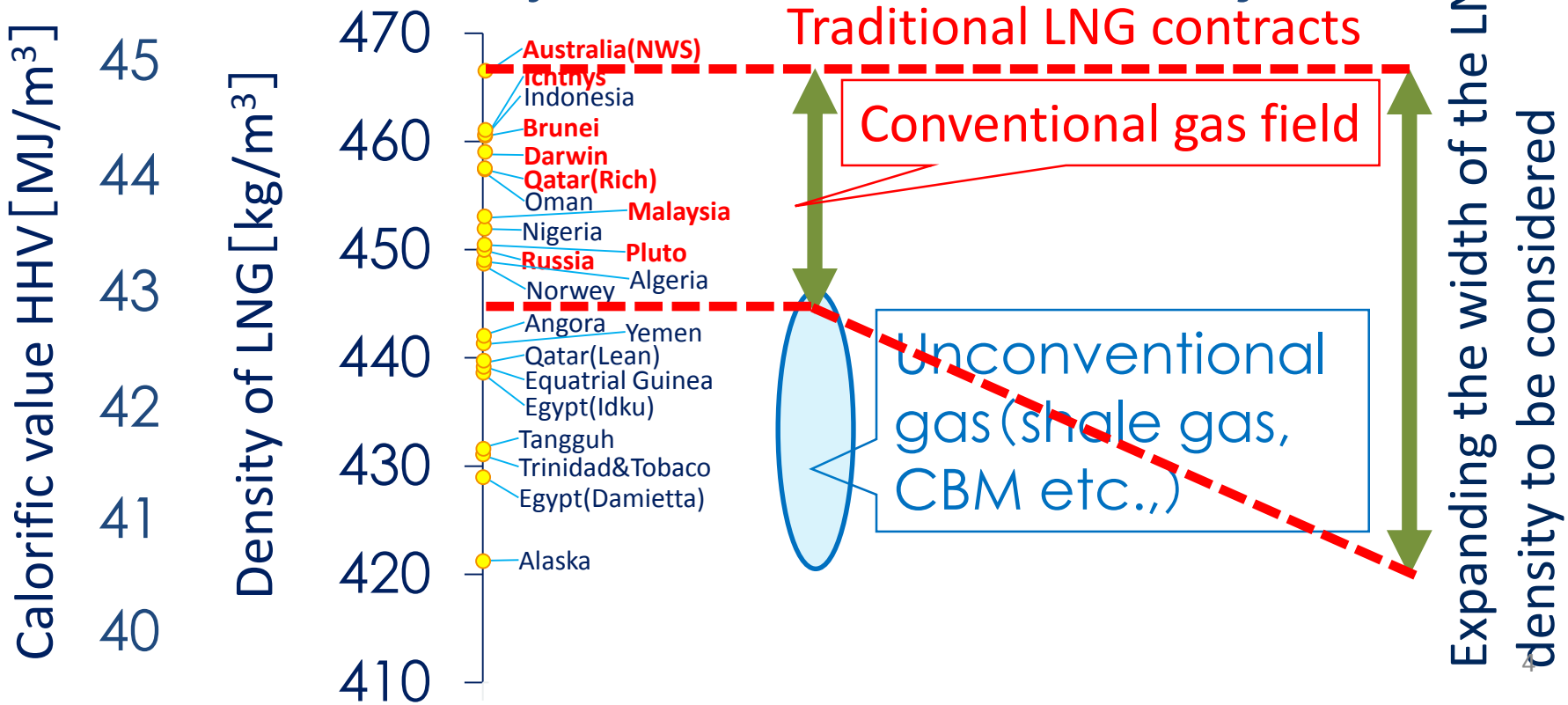
① Diversification of LNG projects

② Flexibility of Sales & Purchase Agreement

Facing difficulties to keep a good balance between flexibility and safety of Terminal operation

①Diversification of LNG projects

LNG density, HHV of each LNG Projects



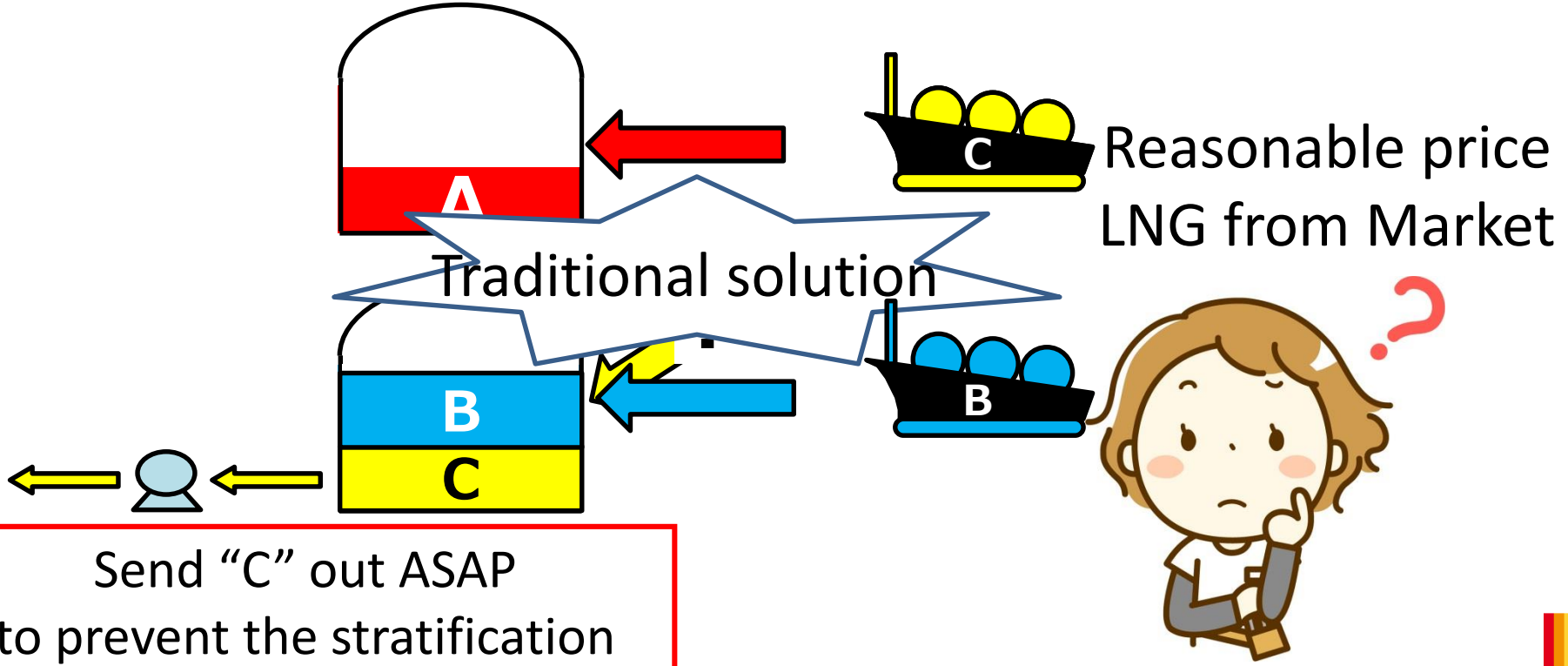
②Flexibility of Sales & Purchase Agreement

Traditional SPA

(Long-term & fixed destination)

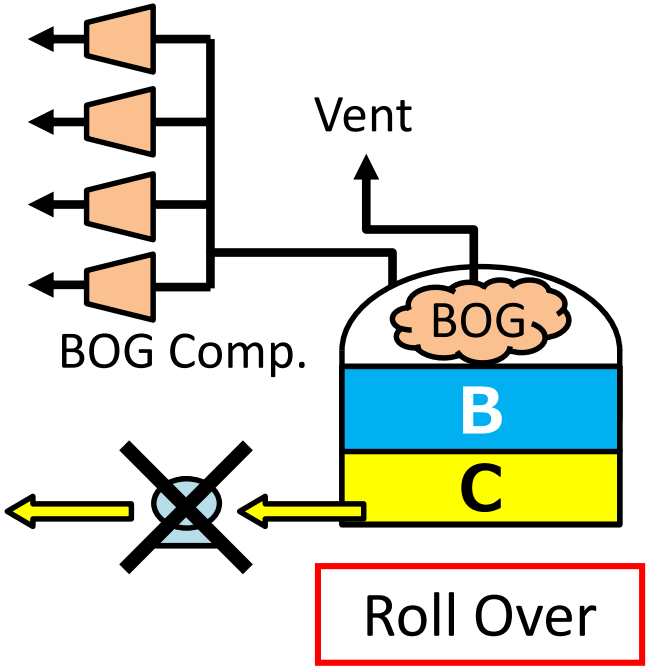
- ✓ Mid- or Short-term contracts
- ✓ Destination free LNG cargos
- ✓ Spot cargos in reasonable price

Facing difficulties between flexibility and safety

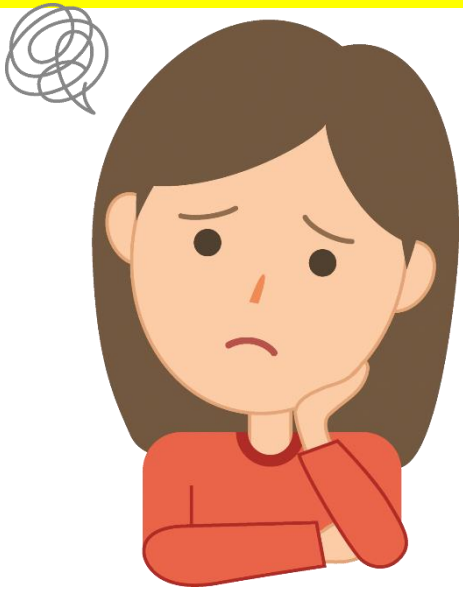


Send “C” out ASAP
to prevent the stratification

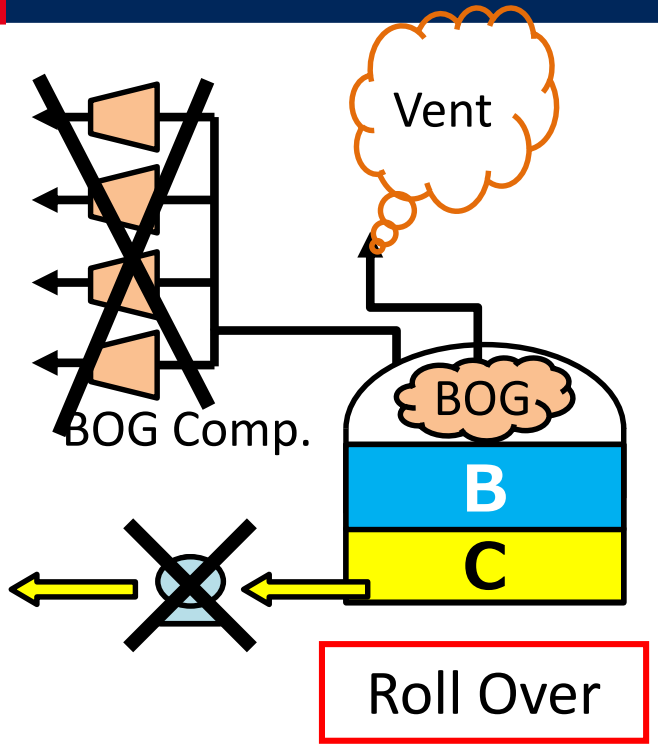
Facing difficulties between flexibility and safety



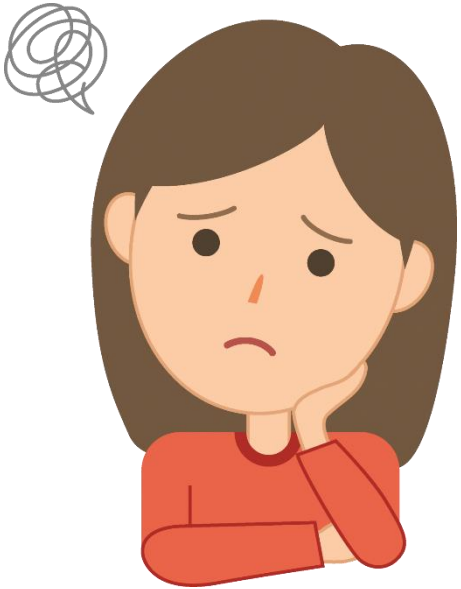
Pump Trip or System Trouble happen



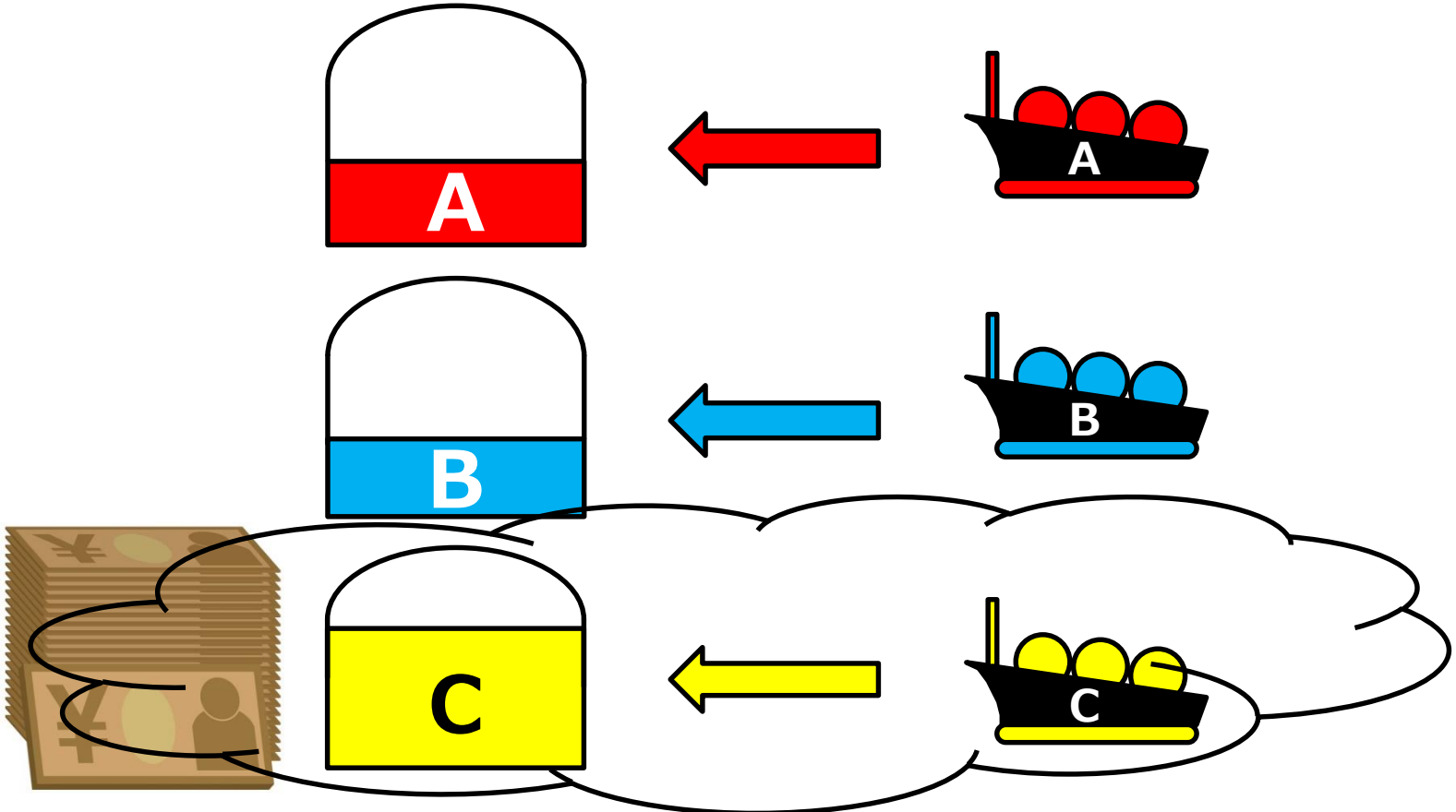
Facing difficulties between flexibility and safety



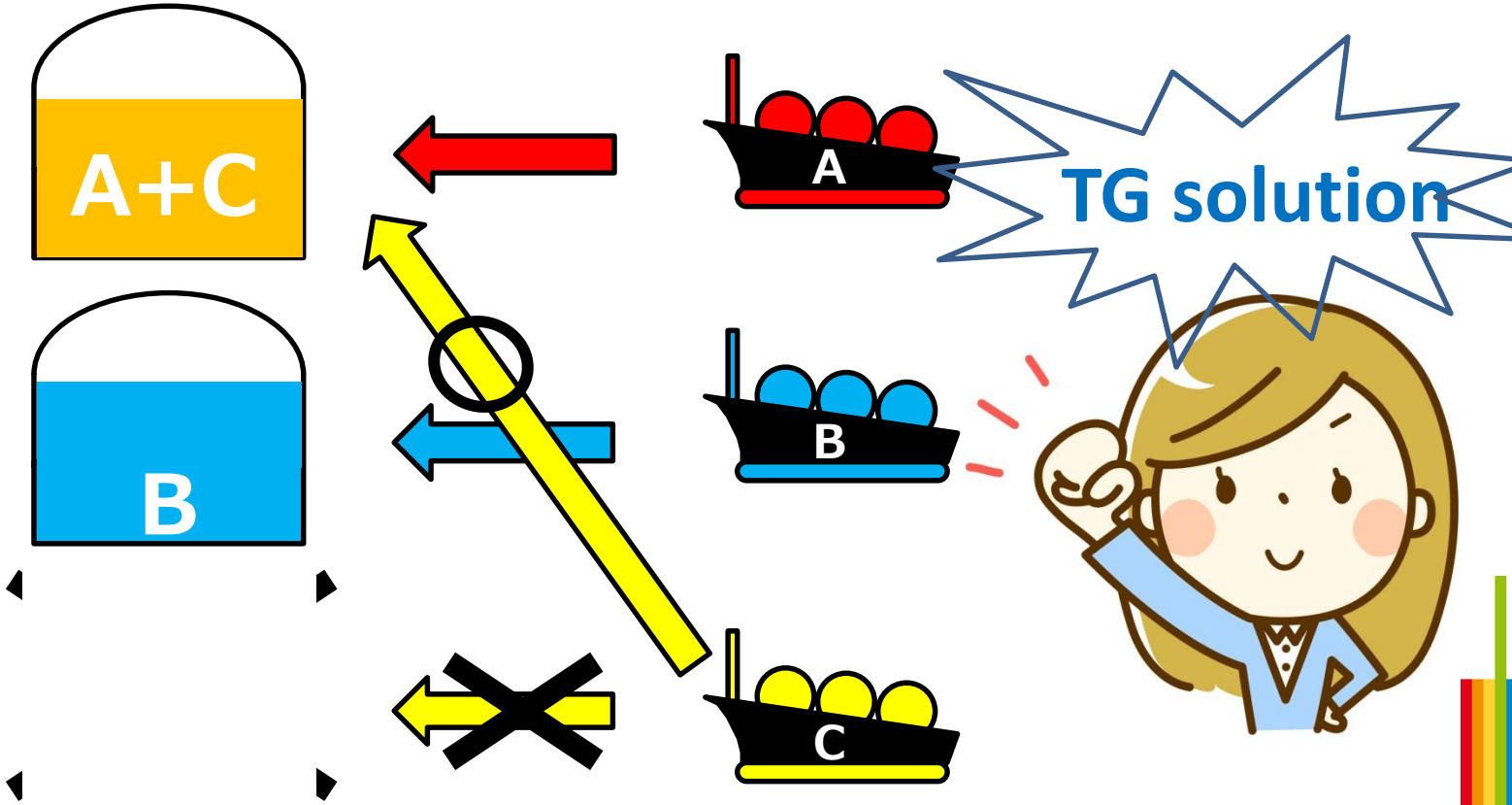
Blackout happen



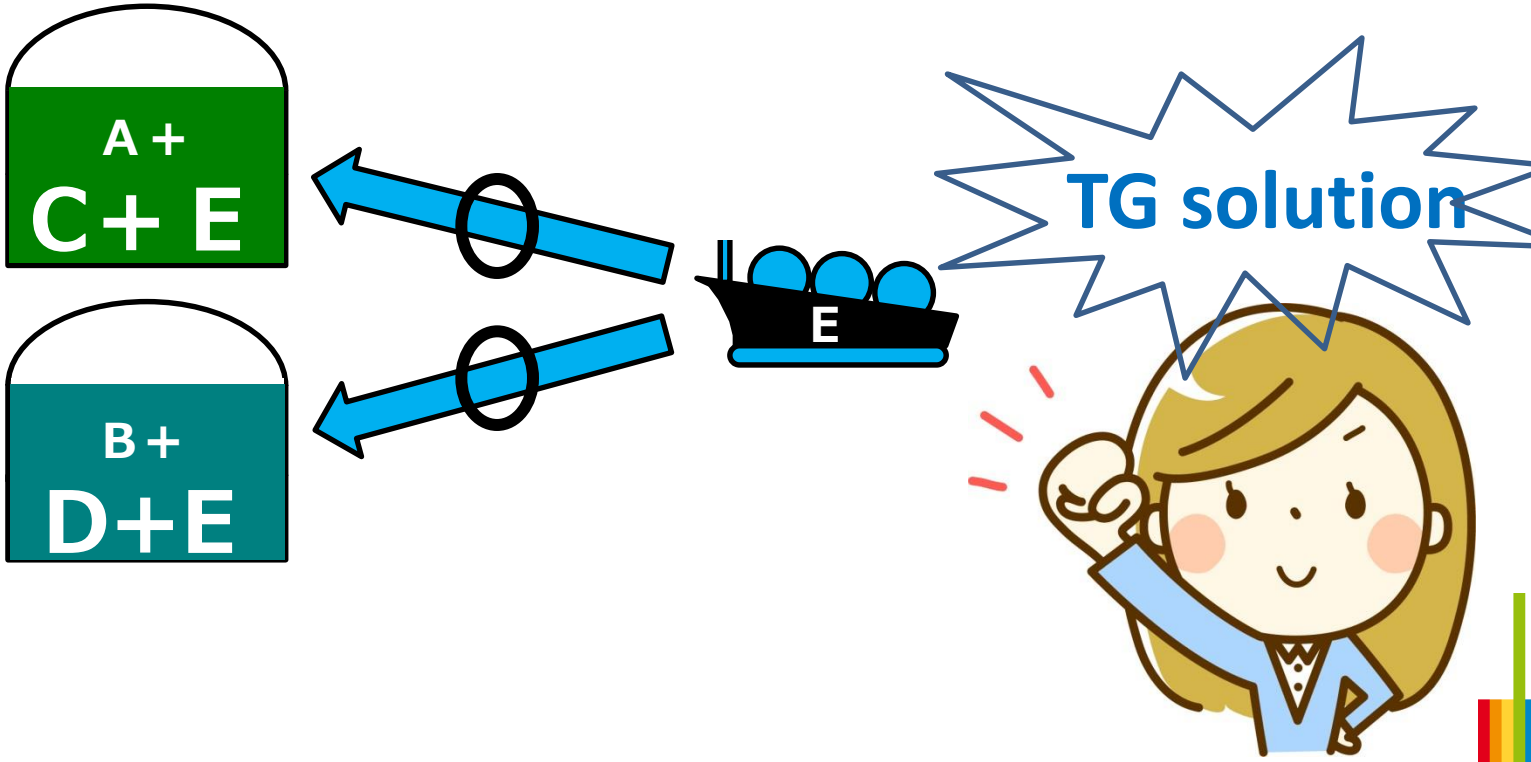
Traditional solution



Tokyo Gas solution



Tokyo Gas solution



TG solution

Completely mixing, wider range of LNG density

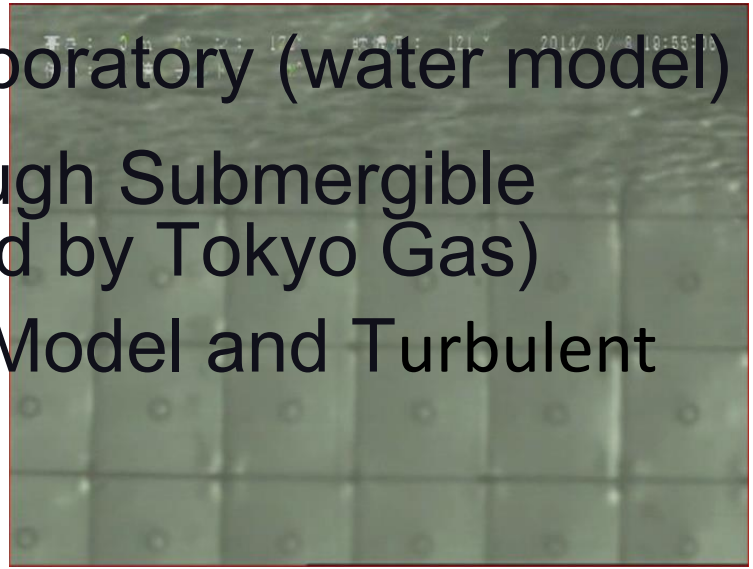
1. Denser LNG onto the top of lighter LNG layer
2. Lighter LNG into the bottom of denser LNG layer
3. Denser LNG into the bottom of lighter LNG layer

Above technology will be applied to LNG tanks **"with or without"** LNG mixing devices

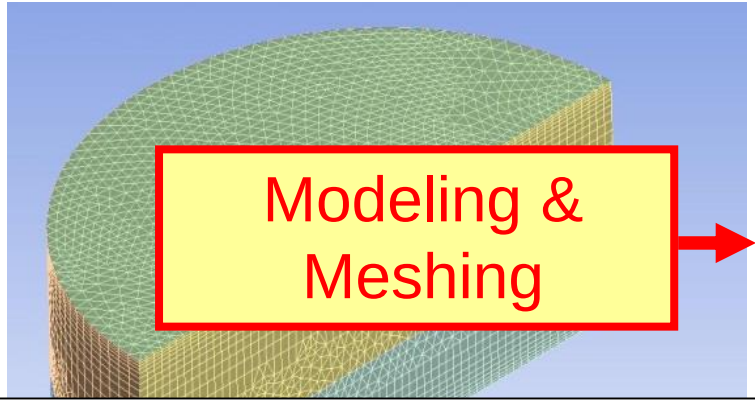
TG solution

Improving LNG mixing simulation reliability

- Huge mixing actual data for CFD model tuning
- Many experiments in laboratory (water model)
- Visual observation through Submergible Camera (Also developed by Tokyo Gas)
- Advanced Multi-Phase Model and Turbulent Flow Model

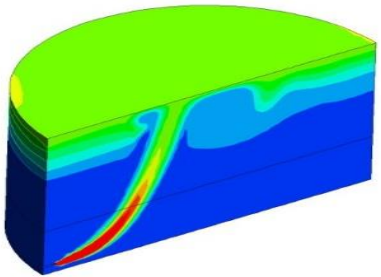


TG Computational Fluid Dynamics Simulation



Modeling & Meshing → Computing (Equation) → Numerical Solution

- ✓ Feeding practical data and conditions of actual LNG tank back into TG CFD simulation model
- ✓ Optimize modeling & meshing, equations in the simulation



Conclusion

- ✓ Reliable prediction of mixing LNGs more widely

  Improving 50% tank turnover ration(TG truck record)
  Purchasing LNG more easily in reasonable price
  Expanding business chances of gas sale

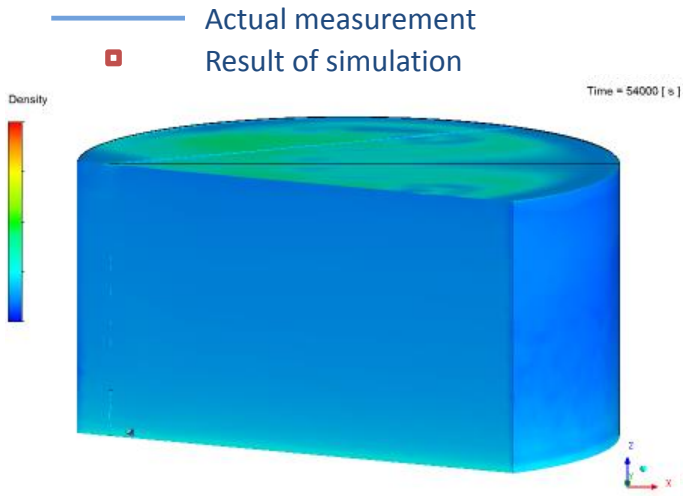
- ✓ Consequently we are able to maximize profit from the most valuable asset “LNG tanks”

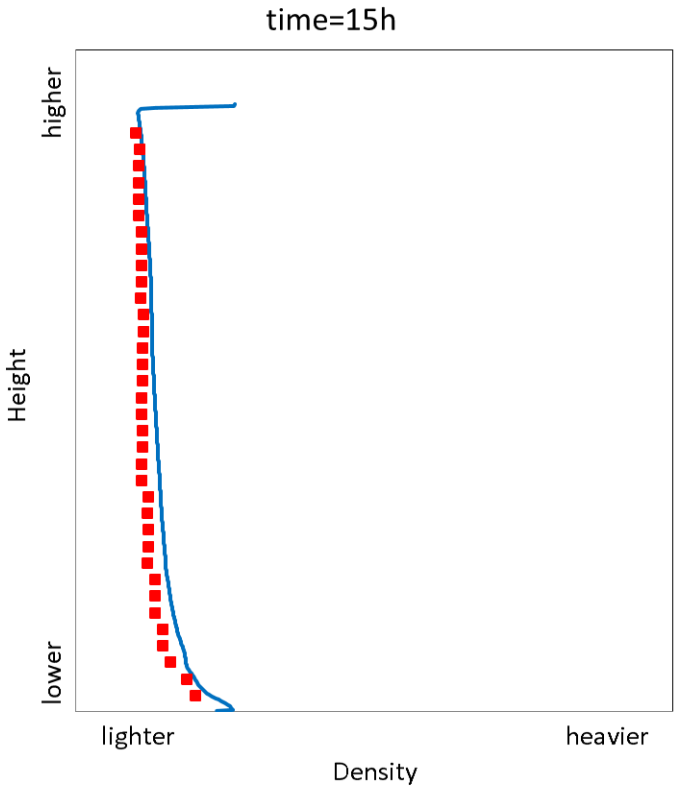
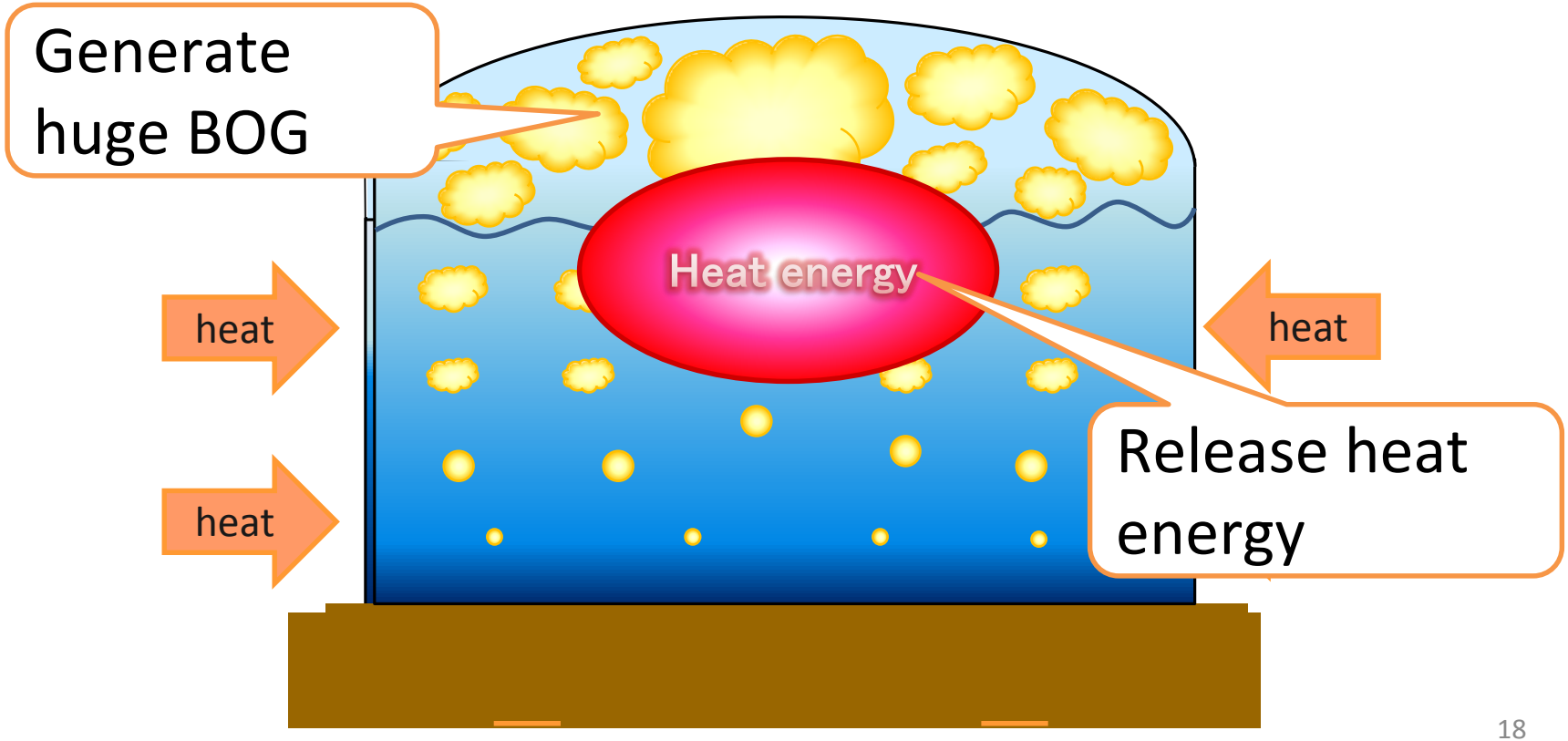
This solution can be adopted to LNG tanks in almost all LNG receiving terminals.

Thank you for your attention

TG Solution

High precision reappearance of lighter LNG filling from bottom nozzle





Rollover phenomenon