Specifying an Appropriate Jet Fire Resistance Test for PFP

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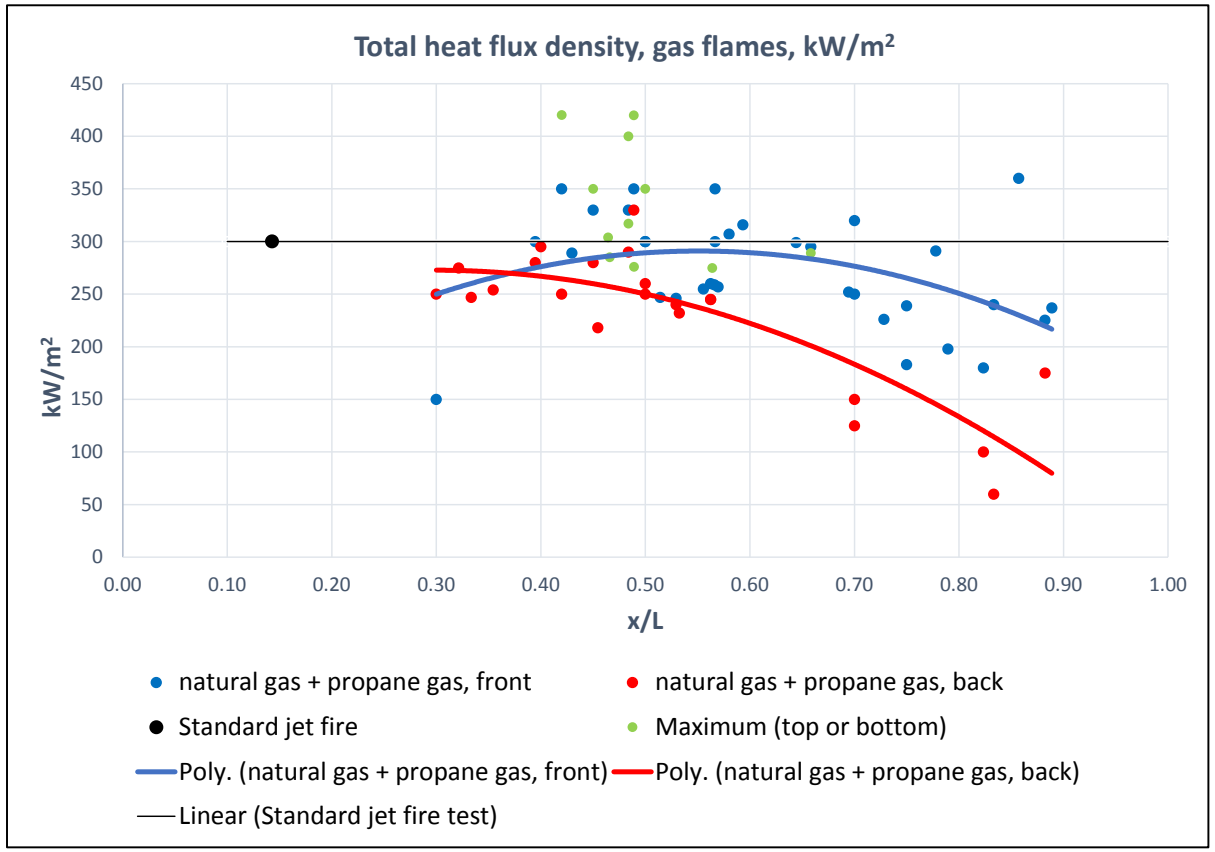
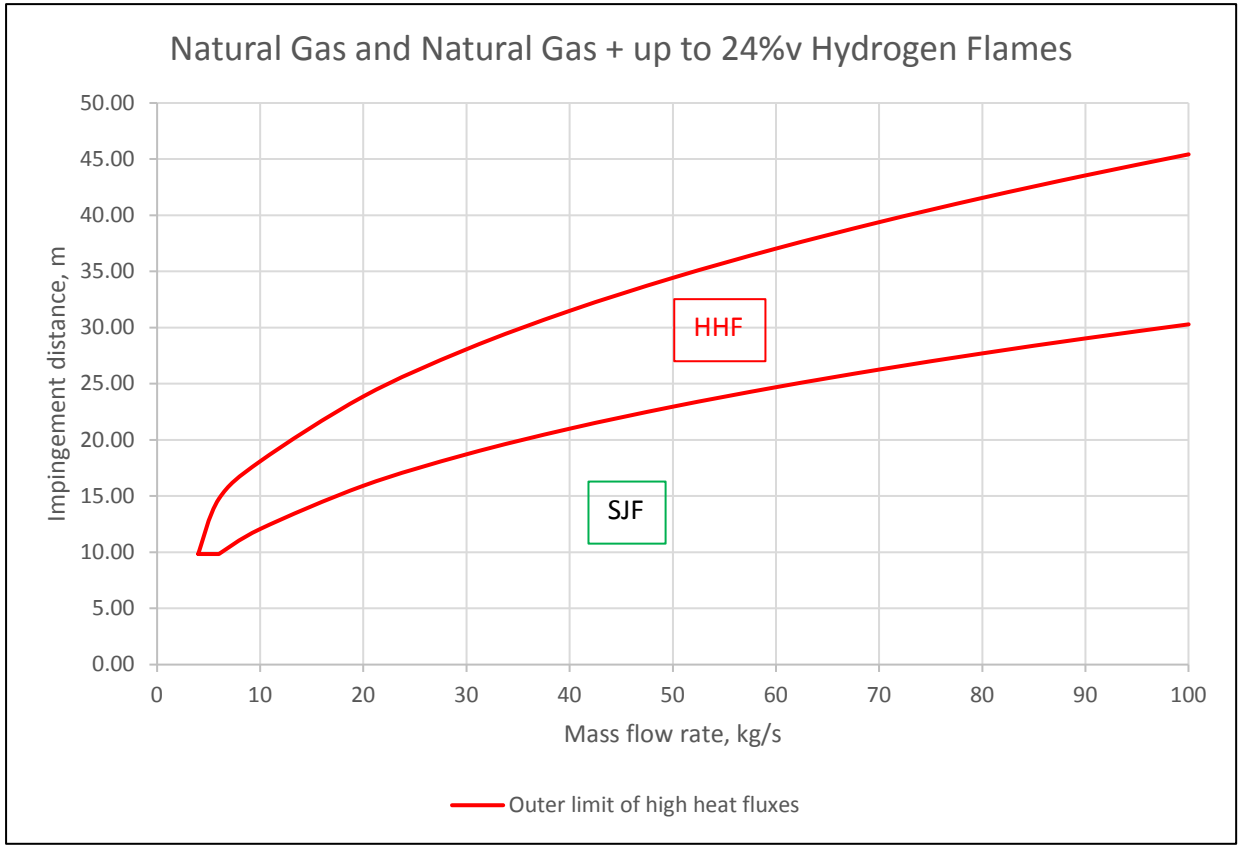
Types of jet fire

- Gaseous, e.g. natural gas, hydrogen, propane, butane, ethylene.
- LPG, e.g. propane, butane, propylene.
- 2 phase, e.g. live crude oil, mixtures of natural gas and oil.

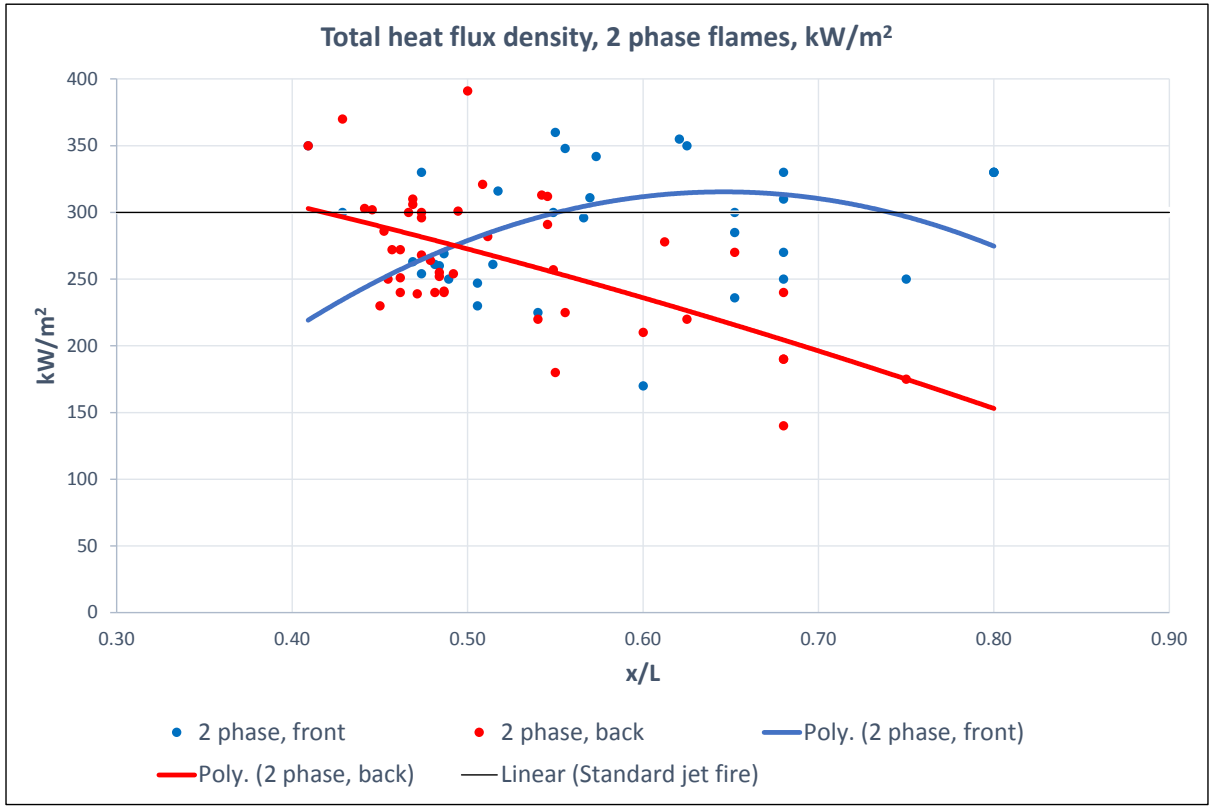
- Fuel or ventilation controlled.

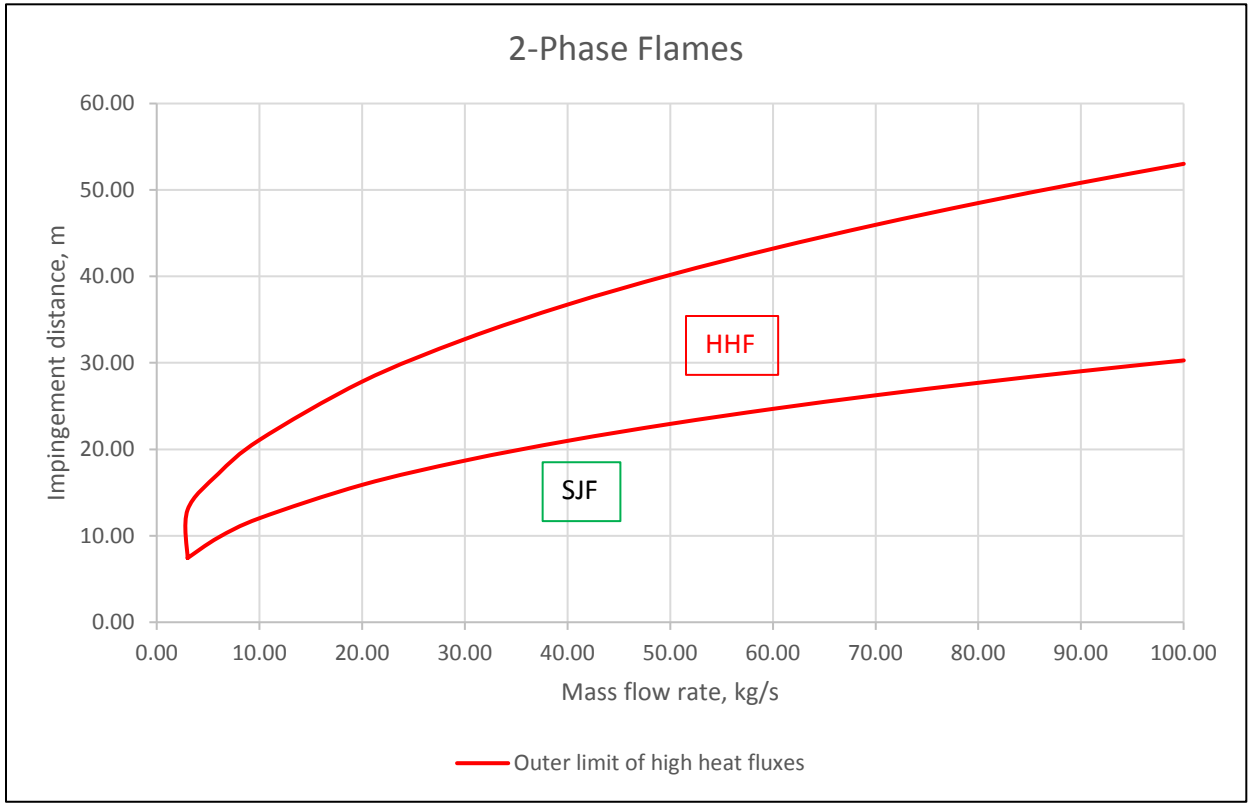
Gaseous jet fires, heat flux and regions of high heat flux (0.4 – 0.6 x/L).



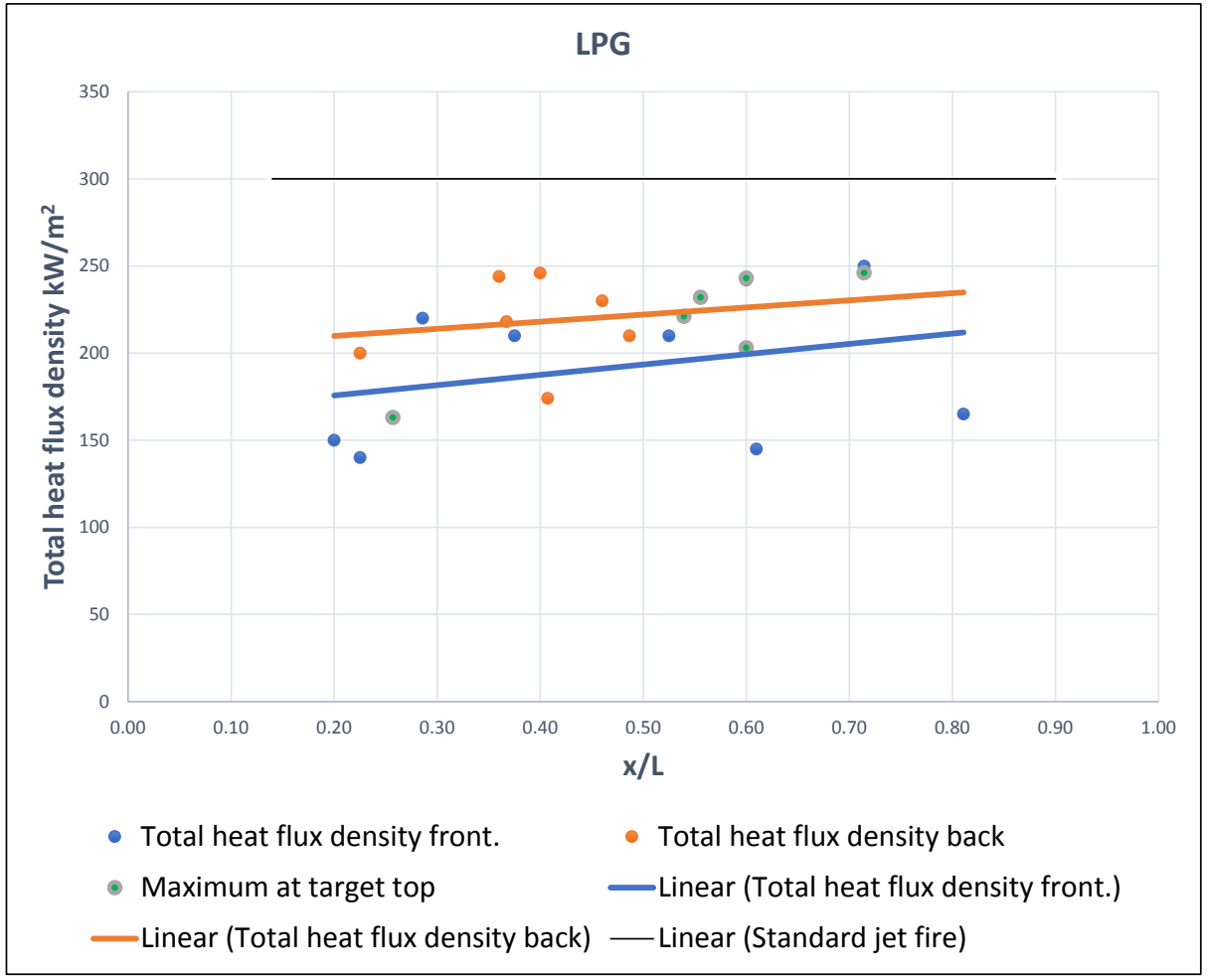


2-Phase jet fires, heat flux and regions of high heat flux (0.4 – 0.7 x/L).

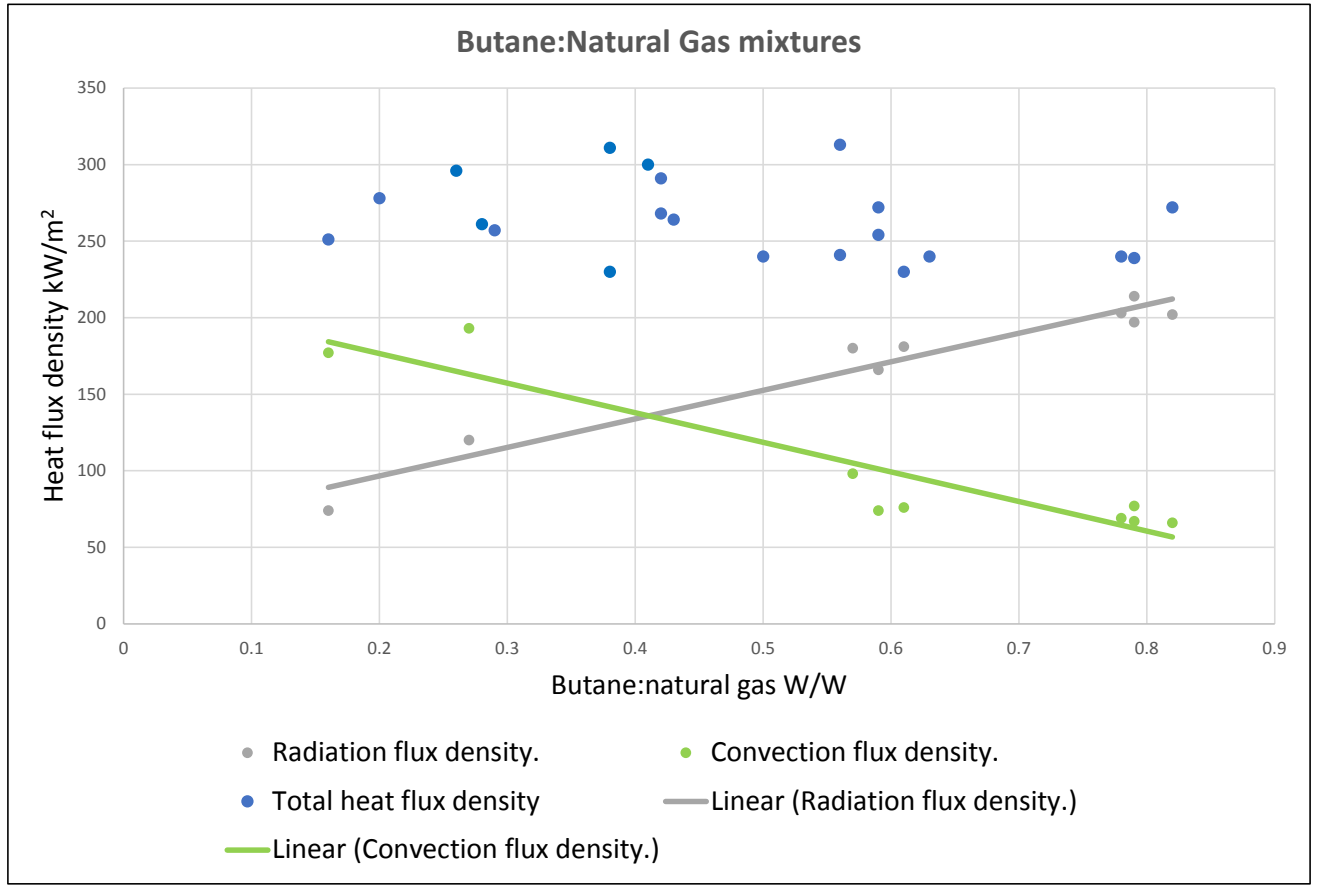


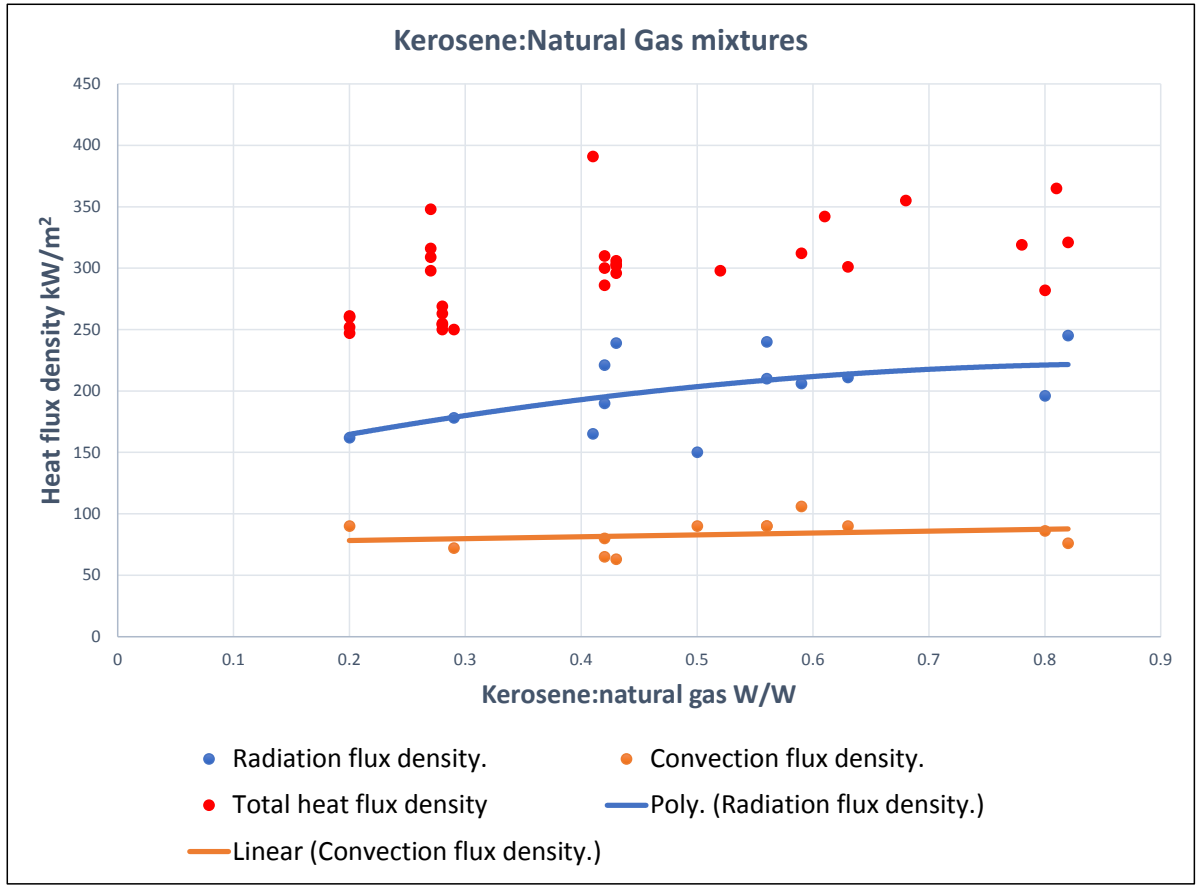


Flashing jet flames, LPG, heat flux.

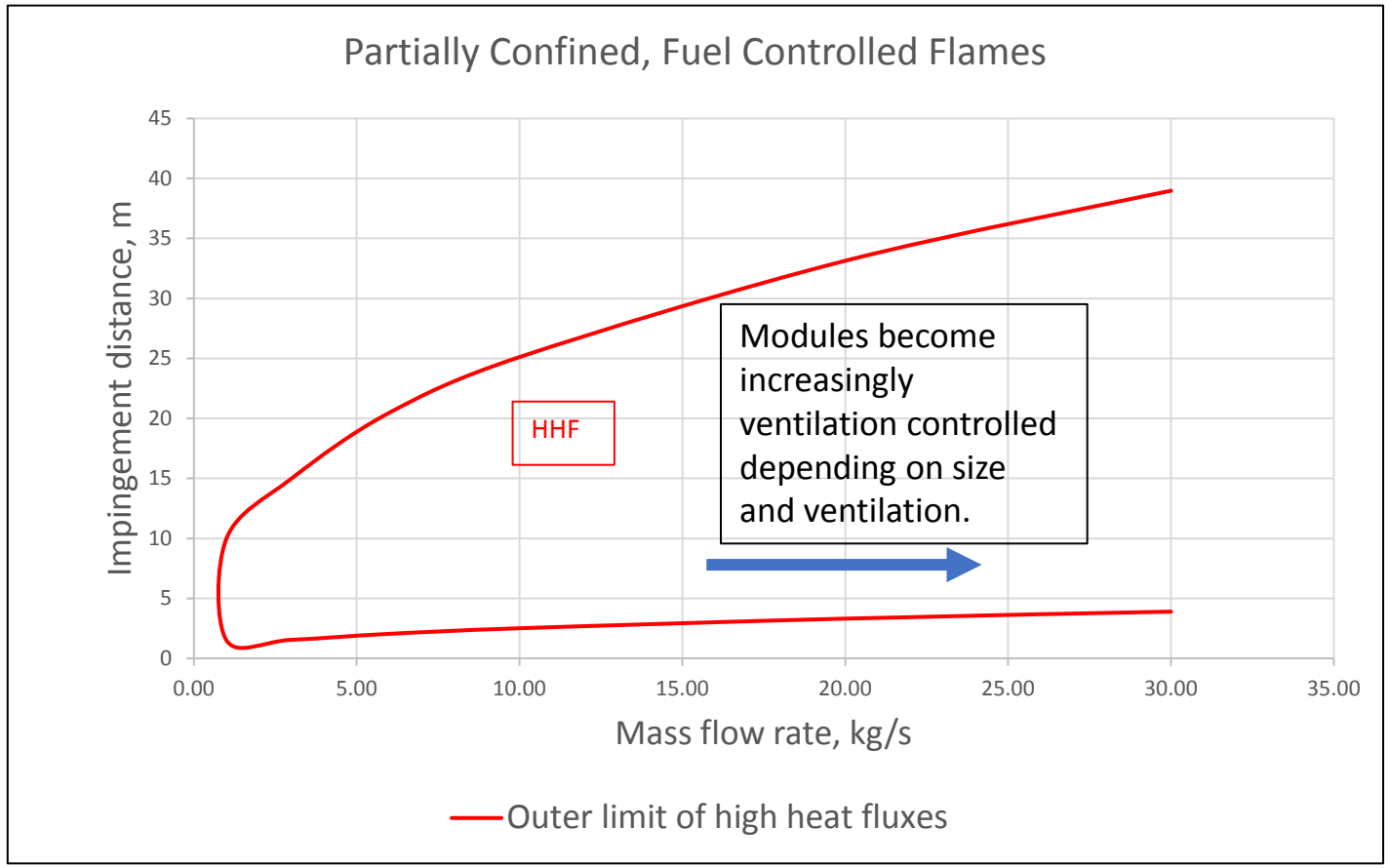


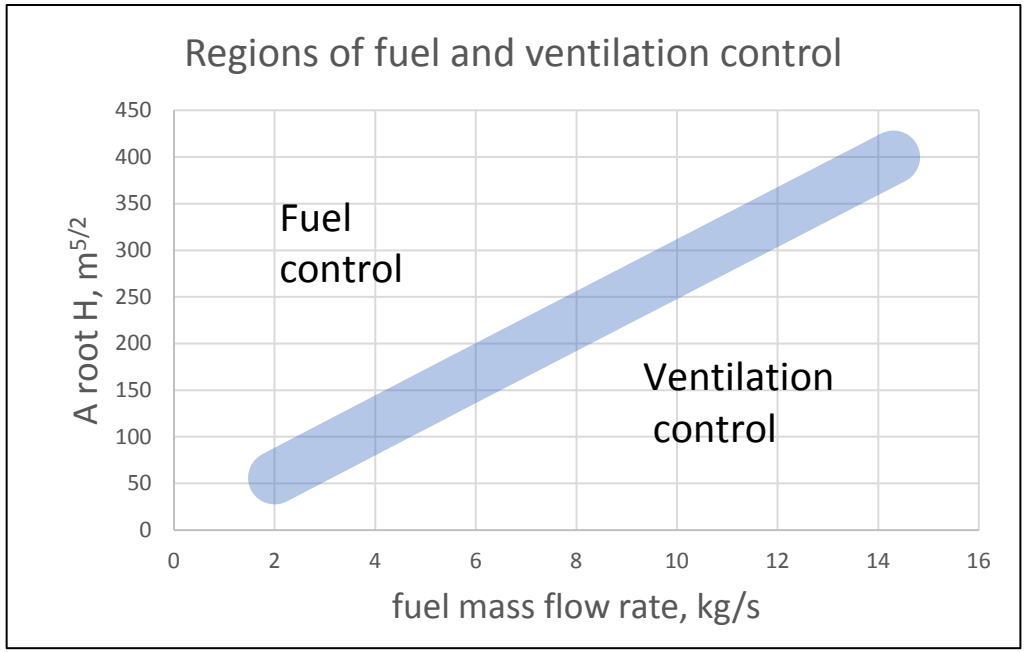
Mixtures of natural gas and butane or kerosene (2.5 kg/s total mass flow rate), heat flux.





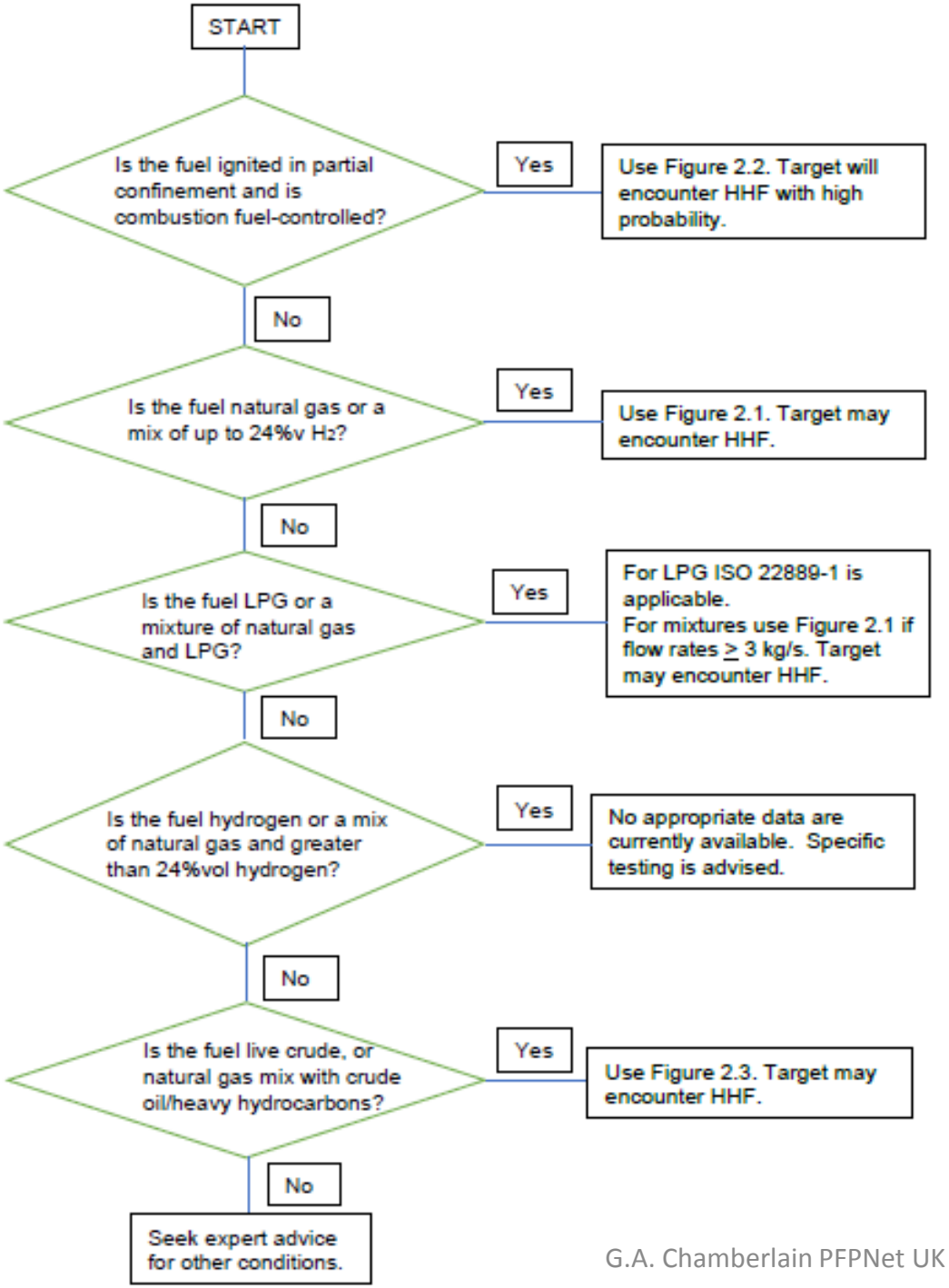
Partially confined, fuel-controlled jet fires.

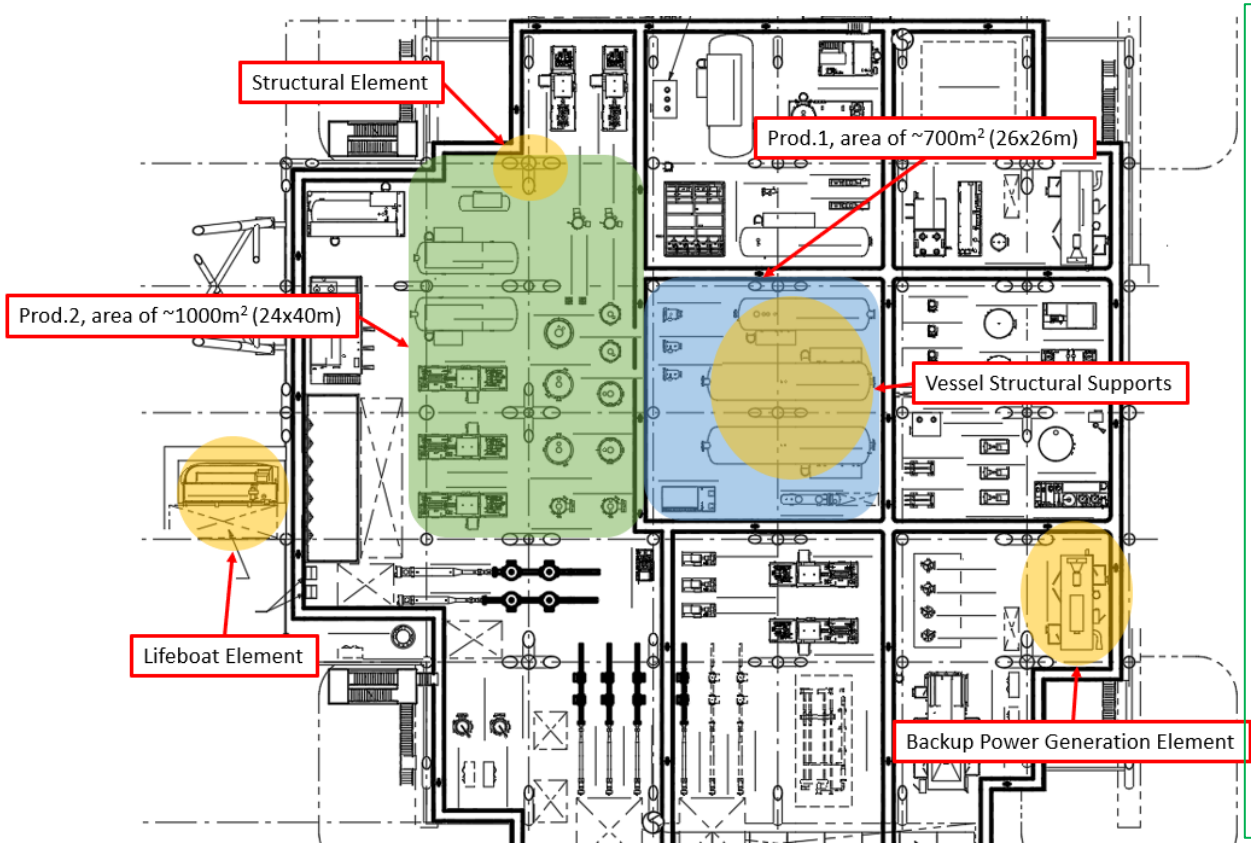




Assume:

- Single vent
- Air:fuel ratio 16
- Smoke 1200K


START
Is the fuel ignited in partial confinement and is combustion fuel-controlled?
Yes
Use Figure 2.2. Target will encounter HHF with high probability.
No
Is the fuel natural gas or a mix of up to 24%v H2?
Yes
Use Figure 2.1. Target may encounter HHF.
No
Is the fuel LPG or a mixture of natural gas and LPG?
Yes
For LPG ISO 22889-1 is applicable.
For mixtures use Figure 2.1 if flow rates ≥ 3 kg/s. Target may encounter HHF.
No
Is the fuel hydrogen or a mix of natural gas and greater than 24%vol hydrogen?
Yes
No appropriate data are currently available. Specific testing is advised.
No
Is the fuel live crude, or natural gas mix with crude oil/heavy hydrocarbons?
Yes
Use Figure 2.3. Target may encounter HHF.
No
Seek expert advice for other conditions.

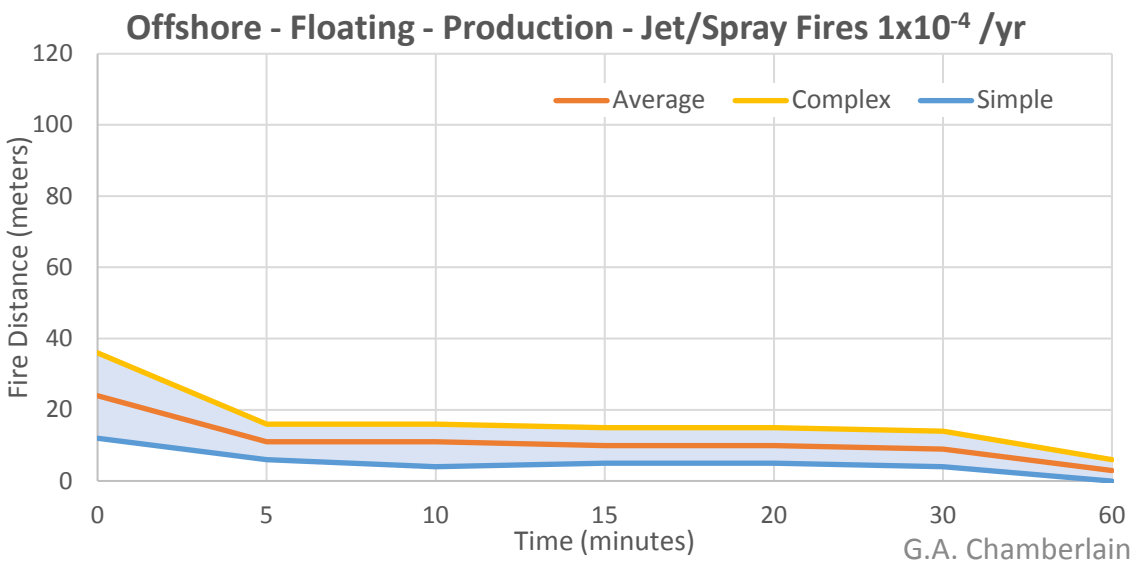


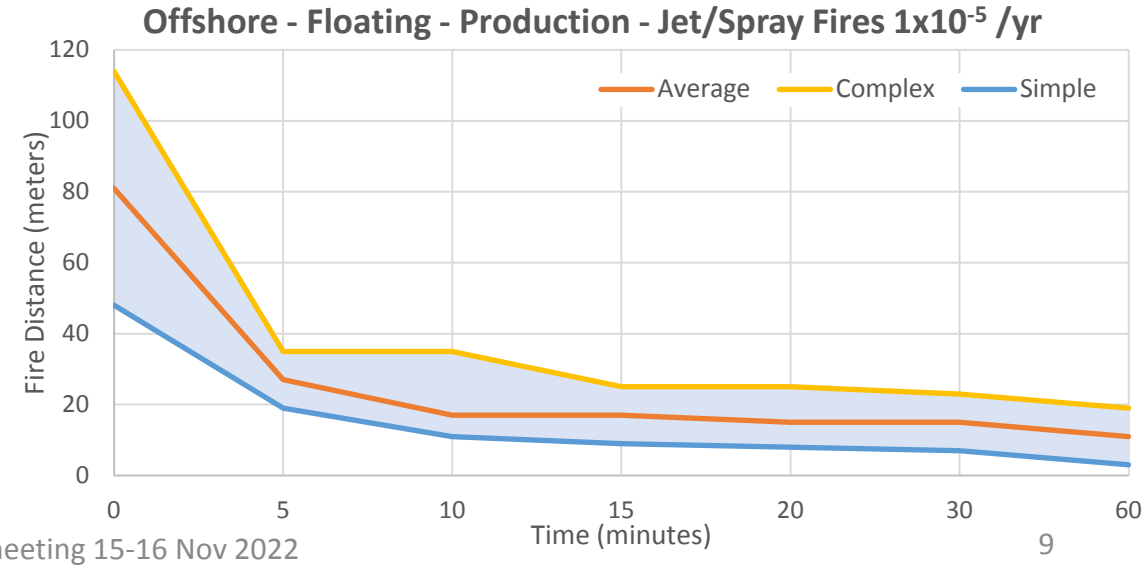
Production Module 2:
2-phase fluids.
Complex.
Assume plated deck and roof.
Assume: height 4m, vent 3m
cladding blown off
in prior explosion.
Vent area: (10+20+40)x3=210
ArootH = 364 $m^{5/2}$

Structural element:
Endurance time 10 min
Fire survival time 20 min
10^{-4} /year Design Load.

Result:
Flame length after 20min = 15m.
Equiv. mass flow rate = 2 kg/s.
From flow chart and curves,
PFP tested to SJF test is suitable.

BUT
Partially confined and thus fuel-controlled jet fire.
So,
HIGH HEAT FLUX EXPECTED!
Will PFP tested to SJF test be suitable for 20 min?



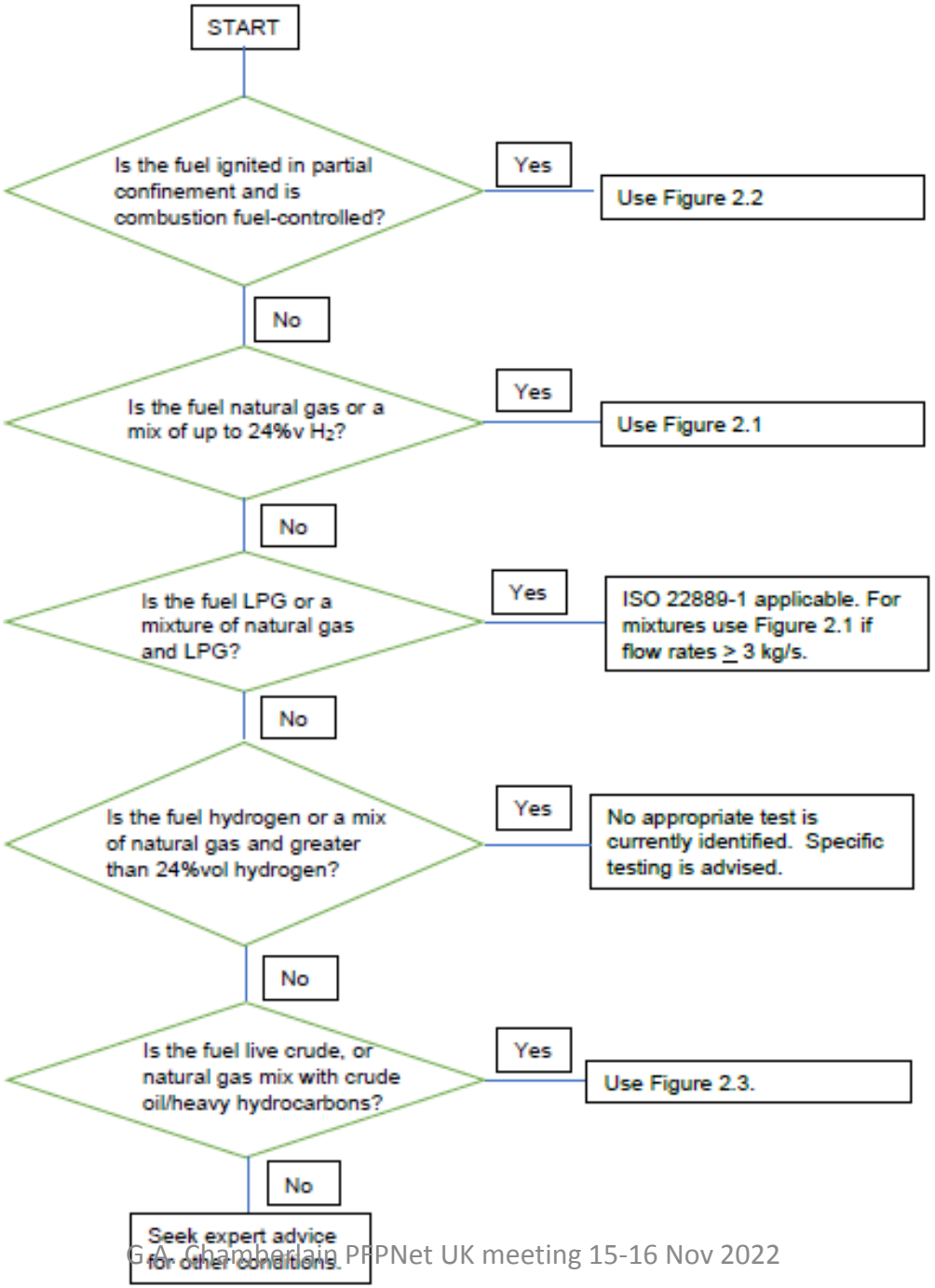


Recommendations

- There is a need to develop and simplify the link between the Design Fire Methodology and the Guidance when HHF would be encountered.
- For PFP that has passed the SJF test (ISO 22889-1) investigate how it would behave in HHF.
- Investigate the heat flux distribution in hydrogen and natural gas/hydrogen jet fires.
- Establish how serious abrasion of PFP is in high momentum jets.

Thank you for listening.

ANY QUESTIONS? (surely yes!)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