Breakout Questions: Day 1 - Group A - IGT

- Temperature Target: ARPA-E aims to develop technologies that would bring a step-change to the field. Is the target of **200C** increase over the SOA high temperature materials a plausible goal?
- What are the likely material systems that should be in the scope to achieve this optimistic target? Comment on refractory metal alloys, RHEA, Ceramics and CMCs
- What should be the specific technical metrics in terms of mechanical properties that a new material must meet at a given temperature?
- What would be the technical & commercial impact of ultrahigh temperature material that can be used at temperatures >200 C higher than the SOA material?
- What are the expectations for useful life, inspection intervals, and feasibility of recoating or repairing high-temp components?
- At what new level of efficiency would early retirement of existing plants become a very real possibility? What would be required to retrofit existing units?
- How much does material cost matter? If efficiency was increased by 5%, but the material were 3X as expensive, would you still consider it? What other features could tip the scales?

arpa·e
CHANGING WHAT'S POSSIBLE

Moderator: Dr. Jack Lewnard (ARPA-E PD)
Notetaker: Dr. Pankaj Trivedi (BAH Tech-SETA)

Breakout Questions: Day 1 - Group A - IGT

Property	Refractory Alloys	RHEA	Ceramics	CMC
Oxidation resistance				
High temperature strength				
Creep resistance				
Fracture toughness				
Fatigue resistance				
Manufacturability				
Cost				
Reliability				
Repair ability				
Overall potential				
Other				

Rating Criteria:
1. Worse
2. Bad
3. Same
4. Better
5. Best

- Use existing Ni-base superalloys as a benchmark
- Discuss in relation to turbine blade application

Supplementary slide if needed for discussion for Q#2

Breakout Questions: Day 1 - Group A - IGT

Property	Alloys	Current State	FOA Target
Tensile Yield Strength (MPa)	Udimet 500	730 MPa (760C)	750-1000 MPa (1000°C)?
	CMSX-10	994 MPa (760C)	
	Udimet 700	830 MPa (760C)	
	DS Mar M200+Hf	925 MPa (760C)	
Creep Rupture Strength (100 h)	Udimet 500	305 MPa (810C)	300-450 MPa (1000C)?
	Udimet 700	400 MPa (810C)	
	DS Mar M200+Hf	465 MPa (810C)	
Fracture Toughness (MPa-$m^{1/2}$)	Ni-based Matls.	90-100	90-100 @T?
Liquidus (C)	Ni-based Matls.	1250-1350	>1500?
Oxidation Res. (x 10^{-6} mg^2. $cm^{-4}.s^{-1}$)	Inconel 718	40 (1100C)	?
Hot Corrosion Resistance	Ni-based Matls.	Good	?
Thermal Conductivity			?
Thermal Expansion Coefficient (10^{-6} K^{-1})	Udimet 700	16-18 (20-800C)	?
	Udimet 500	13.3 (20-100C)	
	Inconel 718	16.0 (20-760C)	

Supplementary slide if needed for discussion for Q # 3