**HLPW4 - High-Order Discretization (meshing and CFD) TFG**

**Key Questions**

These will be listed on web-site to describe the objective of our TFG and what we will be attempting to answer with our test cases.

1. How does the Y+ normal distance requirement vary between finite volume vs. finite element/high order schemes?
2. How does the normal growth rate affect the solutions in finite volume and finite element/high order schemes?
3. What mesh quality metrics are used to evaluate high order meshes?
4. How well do the curved meshes conform to the actual geometry?
5. What is the required spacing in the off-body regions for LES solutions using finite volume and finite element schemes?
6. How should the distance to the wall calculation for turbulence modeling be performed

for high order meshes?

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**Test Cases (Version 1.0)**

**High-Order Curved Mesh Generation**

Curved meshes with degree 2 (Q2) and degree (Q3) polynomial representations are requested (Q2 is required).

1. **Case 1 - 2D HLCRM airfoil (Required)**
   1. Curve provided meshes for the HLPW Case 3a (2d HLCRM airfoil)
   2. Generate custom curved meshes for the HLPW Case 3a (2d HLCRM airfoil)
2. **Case 2 - Juncture Flow Model (Optional)**
   1. Generate custom curved meshes for the provided Juncture Flow Model (JFM) following the JFM meshing guidelines
3. **Case 3 - HLCRM Nominal Configuration (Required)**
   1. Generate curved meshes uses the nominal landing configuration (as in HLPW Case 1a) with inboard/outboard TE deflections of 40°/37° following the curved meshing guidelines for the CRM.

**CFD Calculations**

1. **Case 1 - RANS Method Verification (Required)**
   1. Case Description: Demonstrate mesh convergence on HLPW Case 3a (2d HLCRM airfoil)
   2. Objective: Verify basic mesh convergence criteria using curved meshes.
2. **Case 2 - RANS Juncture Flow Model (Optional)**
   1. Case Description: Compute RANS solutions for the [Juncture Flow Model](https://turbmodels.larc.nasa.gov/Other_exp_Data/junctureflow_exp.html) using [SA-QCR2000](https://turbmodels.larc.nasa.gov/spalart.html#qcr2000) turbulence model with the following conditions:
      1. Re=2.4 million based on crank chord of 557.17
      2. M=0.189
      3. T=288.84 K
      4. Angle of incidence 5.0 deg
      5. Adiabatic wall
   2. Objective: Compare mesh convergence of curved meshes with linear meshes.
3. **Case 3 – RANS HLCRM Nominal Configuration (Required for RANS)**
   1. Compute grid convergence study for linear and curved meshes for the HLRCM nominal configuration (HLPW Case 1a).
   2. Compute study (HLPW Case 2a) with the appropriate grid resolution with curved grids based on the grid convergence study.
4. **Case 4 - RANS HLCRM Nominal Configuration (Required for LES)**
   1. Compute grid convergence study for linear and curved meshes for the HLRCM nominal configuration (HLPW Case 1a) but at 21.46 angle of attack.