1. **Participant Information**

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| --- | --- |
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| Submission year: | 2022 |

1. **Grid Information**

If this submission used an official grid:

|  |  |
| --- | --- |
| Grid name (e.g., medium, fine, etc.): | Inhouse |
| Has pinched rotor casing?\* (yes/no) | No |
| Has stator hub cavity? (yes/no) | no |

\* The official grids released in the 2021 1st GPPS CFD Workshop used a smooth rotor casing (not realistic). The official grids released in the 2022 2nd GPPS CFD Workshop has fixed this error with realistic pinched casing.

If this submission used an in-house grid:

|  |  |
| --- | --- |
| Average y+ of the first layer grid: | 3 |
| Number of grid points in the rotor domain: | 1791783 |
| Number of grid points in the stator domain: | 1608500 |
| Type of grid element:  (e.g., hexahedron, tetrahedron, etc.) | Hexahedral Multi-Block Structured |
| Has pinched rotor casing?\* (yes/no) | No |
| Has realistic rotor and stator fillets? (yes/no) | no |

1. **RANS Flow Solver Information**

(1) General:

|  |  |
| --- | --- |
| Solver name: | UPACS |
| Version number: |  |
| Major reference(s) (optional): | Kazawa, Junichi, et al. "Numerical study on fan noise generated by rotor-stator interaction." 13th AIAA/CEAS Aeroacoustics Conference (28th AIAA Aeroacoustics Conference). 2007. |

(2) Advection Scheme:

|  |  |
| --- | --- |
| Branch of scheme (e.g., JST, ROE, AUSM): | ROE |
| If not listed above, please briefly describe the advection scheme and include a major reference to the scheme: | |

(3) Turbulence Model:

|  |  |
| --- | --- |
| Model name\*: | SA-R-H-QCR2000 optimized |
| If not documented in NASA TMR, please briefly describe the turbulence model and include a major reference to it:  ROTATION-HELICITY-QUADRATIC CONSTITUTIVE RELATION SPALARTALLMARAS (R-H-QCR SA) MODEL FOR THE PREDICTION OF MULTI-STAGE COMPRESSOR CHARACTERISTICS” | |

\*Please follow the naming convention of [NASA TMR](https://turbmodels.larc.nasa.gov/). Note that the turbulence model implemented in the solver may differ from the standard version of the model (e.g., SA vs. SA-noft2, SST vs. SST-2003, etc.)

(4) Viscous wall treatment:

|  |  |
| --- | --- |
| Use of wall function (yes/no): | No |
| Use in-house grid with y+ > 10 (yes/no): | No |
| If both yes, please briefly describe the wall function and include a major reference to it: | |

(5) Rotor-stator interface model:

|  |  |
| --- | --- |
| Type of model for mean flow quantities\*:  (e.g., frozen rotor, mixing plane, non-reflecting (Giles)) | Mixing plane with Buffer layer non-reflecting treatment |
| Type of model for turbulence quantities\*:  (e.g., frozen rotor, mixing plane) | Mixing plane (conventional) |
| Please briefly describe the rotor-stator interface model and include a major reference to it (optional):  The “Mixing plane with Buffer layer non-reflecting treatment” is described in the following paper.  Tani, N., Simple Non-Reflecting Mixing-Plane Method for Multi-Stage Turbomachinery CFD with Improved Conservation, Proc. of Asian Joint Conference on Propulsion and Power, 2018 | |

\* Mean flow quantities are *p*, *T*, *u*x, *u*y, *u*z, etc.; turbulence quantities are eddy viscosity, *k*, *ω*, etc.

(6) Other details (optional):

|  |  |
| --- | --- |
| Fluid model (e.g., real gas, idea gas): | Ideal Gas |
| Linear system solver (e.g., Jacobi, etc.): | Matrix free Gauss-Sidel |
| Have you verified your solver in [NASA 2D flat plate](https://turbmodels.larc.nasa.gov/flatplate.html) against established RANS solvers? (yes/no) | Yes |

1. **Boundary conditions**

(1) Inlet:

|  |  |
| --- | --- |
| How were the mean flow quantities determined? (e.g., from InletBC.input file; uniform inlet at standard conditions) | from InletBC.input file |
| How was the turbulence quantity(s) determined? (e.g., values and units of inlet *k* and *ω*) | t= 0.00252[Pa s]  (Sensitivity study was carried out) |

(2) Outlet (optional):

|  |  |
| --- | --- |
| What type of boundary condition is used? (e.g., uniform backpressure, radial equilibrium backpressure, mass flow, Riemann, etc.) | Radial equilibrium backpressure |

(3) Periodic boundary (optional):

|  |  |
| --- | --- |
| Have you checked the periodicity of mean flow quantities? (yes/no) | Yes |
| Have you checked the periodicity of turbulence quantities? (yes/no) | Yes |

1. **Convergence History**

A figure of mass flow rate (rotor inlet, rotor exit/stator inlet, and stator exit) versus iteration

|  |  |
| --- | --- |
| Peak efficiency condition (16.00 ± 0.10 kg/s) | Near stall condition (14.78 ± 0.10 kg/s) |
|  |  |

A figure of residual versus iteration (optional)

|  |  |
| --- | --- |
| Which quantity's residuals are plotted? |  |
| How was the residual defined? (global or local; maximum or average; absolute or relative, etc.) |  |
| Peak efficiency condition (16.00 ± 0.10 kg/s) | Near stall condition (14.78 ± 0.10 kg/s) |
|  |  |