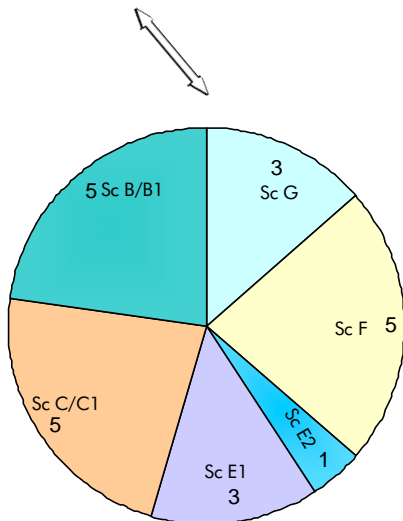
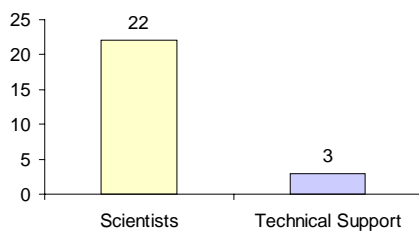


# COMPUTATIONAL AND THEORETICAL FLUID DYNAMICS DIVISION

## SUMMARY

**Dr S S Desai, Head**



More realistic practical problems arising in the aerospace field and more ambitious projects in the area of basic fluid and computational mechanics mark the developments in the Computational and Theoretical Fluid Dynamics Division during the year 2001-2002.

On the practical side, more and more support is being given to the improvements to the configurations of NAL's two main aircraft projects, viz. SARAS, the 9-14 seater multi-role commuter aircraft and HANSA, the already type-certified all-composite two-seater trainer aircraft.

On the HANSA aircraft it was felt that there was room for improvement in the flap configuration. Computations carried out using a Reynolds-averaged Navier-Stokes code, developed in-house, very convincingly demonstrated the possibility of large improvements to the flap aerodynamics. The improved flap geometry is now being integrated on to the HANSA aircraft for flight demonstration.

The different RANS codes developed in the Division have now matured with specific emphasis on (a) low-speed steady and unsteady flows with emphasis on different turbulence models, (b) time-accurate computation of unsteady compressible flows, (c) transonic and supersonic flow computations for steady flows

and (d) steady and unsteady flow computations at hypersonic Mach numbers. All these codes are now being put to use for the generation of data for in-house projects of NAL as well as for sponsored projects from outside agencies. Computations using the RANS solvers for the complete configurations of the LCA and SARAS aircraft have been the important milestone in the achievements of the Division.

The Division continues to provide computational support to the requirements for flow diagnostics and data generation for some of the important national projects being pursued by the Aeronautical Development Agency (ADA), the Defence Research and Development Laboratory (DRDL), the Naval Science and Technology Laboratory (NSTL), the Aeronautical Development Establishment (ADE) and the Indian Space Research Organisation (ISRO).

The new initiatives include studies in the problem of sloshing under microgravity, and in the area of large-eddy simulation (LES) for arbitrary shaped underwater bodies.

Some interesting studies this year included details of flow pattern around square and circular cylinders, RANS computations to study the effect of wing tip configuration on the induced drag, computational demonstration

of vortex roll-up from the sides of slender shapes typical of aircraft nose shapes, improvements to convective flux discretisation schemes to resolve the so-called stagnation-point anomaly, and development of adaptive Cartesian meshes around

complex shapes.

There were four sponsored projects and ten in-house projects in operation in the Division. During the year seven in-house projects were closed after meeting their objectives.

There were eight external publications, 17 internal reports and five presentations in national and international conferences. The Division's collaboration with DLR, Braunschweig is now taking shape in the area of aero-acoustics.