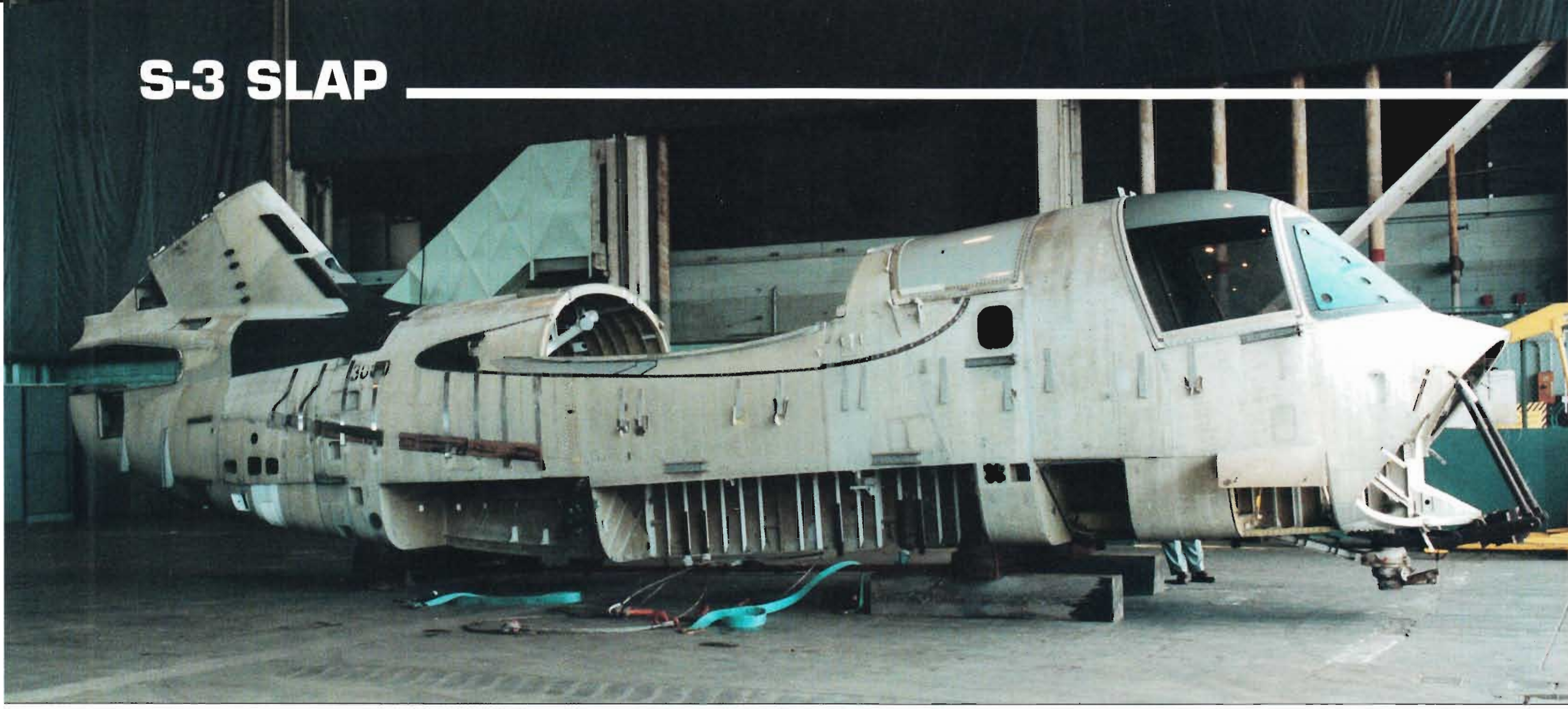

The original S-3 fatigue test article, known as Ship 3000, as it appears today in a Lockheed hangar. It was almost scrapped after its first fatigue testing program, and has proved essential to the SLAP tests.

S-3 Viking Service Life Assessment Program

By David Reade

Twenty years ago the first Navy S-3 Viking officially took to the air and began two decades of carrier battle group service. Since then, the S-3 fleet has logged an average of 6000 flight hours per aircraft with over 1000 catapult launches and arrested landings. That constitutes approximately one half of the designed service life of 13,000 flight hours, a validation made by Lockheed's S-3 fatigue test article. With a desire to operate the Viking well into the next century, the Navy has initiated a Service Life Assessment program to determine the S-3's remaining fatigue life using updated fatigue spectra based on anticipated usage.

Lockheed was selected to conduct the study and has implemented the SLAP project at its Marietta, Georgia facility. The goal of the project is to assess the extension of the Viking airframe to 17,500 hours for operation to the year 2015. The SLAP project will be accomplished in two phases. The first phase includes developing tools and procedures to conduct the actual structural analysis, while the second phase identifies local areas needing attention to achieve the S-3's service life goal.

The results from the second phase will determine if a follow-on "Service Life Extension Program" or SLEP is required. The SLEP is where selected modifications would be made.

The Slap process began with an examination of the original S-3 fatigue test article. Access holes were cut into critical areas of the wings, fuselage and empennage structures to inspect for hidden cracks. Some fastener holes were checked, with cross section samples being removed and examined under scanning electron microscopes.

One of the tools developed for the SLAP process is the S-3 Finite Element Model. The model is a computerized three dimensional highly detailed re-creation of the Viking airframe structure. It was developed from the master dimensions or loft lines of the S-3. Results from the model, coupled with information from the original fatigue test article and mission profiles developed from the past twenty years, can be used to assess the current state of the aircraft's service life.

The Finite Element Model also allows stress tests to be conducted within the computer, simulating the stresses and strains of flight that once took thirty tons of steel and 133 computer-controlled hydraulic jacks to create. This computer generated process can locate stress points and indicate where modifications will be required to prevent fatigue. The model can even be used to help evaluate and test the longevity of the computer generated modifications to the aircraft.

Additionally, with the aid of a new set of computer programs called "Load Systems", the model can calculate in-flight stress loads that the aircraft is expected to experience in the future. This includes pilot maneuvers and air turbulence at numerous altitudes under different weapons loads as well as the stress loads from catapult takeoffs and arrested landings.

The information generated on the proposed flight parameters will come from an updated in-flight data recording system known as SDRS or Structural Data Recording Sets. SDRS is currently being installed on fleet S-3s and will record in-flight data such as altitude, weight, speed and acceleration. The data will be applied to the Load System Programs.

In the future, many of the problems associated with the structural modifications, will be solved by the information generated by the Load System Programs in conjunction with the Finite Element Model.

The fatigue test article examination analysis and the Finite Element Model have been delivered to the Navy. The load system programs and recommendations for any possible SLEP extension project will be forwarded next Spring. ★

On the S-3 airframe Finite Element Model or FEM, 22,784 grid point locations were generated from aircraft loft lines and used to form a computer generated mesh of 50,294 finite elements which represent all load-bearing structure. The goal is to calculate stress levels and help locate fatigue problem areas.

Years ago, the S-3 fatigue test article, Ship 3000, completed two typical lifetimes while nearly hidden in its 60,000 pound cage of steel and hydraulic jacks, where it could feel all the stresses and strains of actual flight.

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