The JSF Conformity Strategy

Modeling to Meet CAA Requirements

The Joint Strike Fighter (JSF) Program is working hard and early to ensure compliance with the Clean Air Act's (CAA) general comformity requirements for air emissions.

The basing of a new aircraft system has the potential to impact the environment of the community surrounding a military installation. CAA's General Conformity requirements and changing National Ambient Air Quality Standards (NAAQS) both deal with air emission issues and must be factored into basing decisions. Although the deployment of the JSF is not scheduled to begin until 2008, the JSF Program's Environmental, Safety and Health (ESH) Team began to anticipate constraints to deployment long before the manufacturer was selected and before any JSF-derived air emission data were available.

The latest emission estimates have been made using the best available information, so that basing decisions can be made with regard to military considerations alone, unrestrained by air quality impact considerations. The JSF strategy is to continuously revise estimates as the program matures and more accurate emission data are generated by the propulsion contractors.

Like other aircraft programs, the JSF Program is working to ensure compliance with the CAA general comformity requirements for air emissions. Here, an AV-8B Harrier jump jet prepares to take off from the flight deck of the amphibious assault ship USS BATAAN (LHD 5).

U.S. Navy photo by Photographer's Mate 3rd Class John Taucher

Overview of Regulatory Requirements

The General Conformity regulations of the Clean Air Act require that the agency responsible for the action verify that the action (in this case, the JSF flight test program) conforms with the appropriate State Implementation Plan(s) (SIP) for an area that is not in attainment or is in maintenance status with regard to the NAAQS. In this case, the Navy is the agency for the basing of the Carrier Variant (CV) and Short Take-Off and Vertical Landing variant and the Air Force is the agency for the basing of the Conventional Take-Off and Landing (CTOL) variant. (See sidebar.) For areas without a SIP, the action must conform to the relevant Federal Implementation Plan (FIP). If an action is found to interfere with the ability of an area to reach attainment, the action is prohibited by Section 176(c) of the CAA. The regulation does allow for certain exemptions for those actions that are either presumed to be insignificant or that have been found to be insignificant in

past actions. It is unlikely, however, that an aircraft basing decision will meet any of the exemption criteria.

A De Minimis Project

If the action does not qualify for an exemption or presumption, then the agency must determine if the action can be excluded as a "de minimis" project. [NOTE: "De minimis" defines a pollutant ceiling below which project activities are allowed. Project activities that exceed this ceiling will require additional analysis.] This is accomplished by comparing the total of direct and indirect emissions for each nonattainment pollutant resulting from project activities (on a tons per year basis) to the conformity de minimis threshold values found in 40 Code of Federal Regulations 51.853. If the total falls below the de minimis threshold values, the action is exempted from further analysis as long as it doesn't equal or exceed 10 percent of the air quality control area's emission inventory for each nonattainment pollutant. Many aircraft replacement situations in moderate ozone nonattainment areas will be de minimis, but large deployments at bases in serious and severe ozone nonattainment areas will probably not be de minimis. If the project is above the de minimis thresholds, the agency must conduct a full-scale conformity analysis culminating in a conformity determination.

The CAA requires that States with areas that are declared nonattainment to develop an emissions budget that makes steady progress towards attainment until satisfied by the deadline established in the CAA. Once the area has an emissions budget in place, the State develops rules and regulations to ensure that they will reach the emissions targets. Although local agencies cannot directly regulate mobile source emissions, they can develop regulations that could indirectly decrease mobile source emissions. Such actions may include capping the number of aircraft landings and takeoffs that are allowed to take place, or requiring flight line electrical power where aircraft are parked to cut down on emissions from Ground Support Equipment (GSE).

The Particulate Matter Standard & 8-Hour Ozone

The particulate matter (PM) and 8-hour ozone are new standards that will affect how newly introduced air systems will comply with the CAA.

The U.S. Environmental Protection Agency (EPA) promulgated the PM standard and implementation schedule again in 2003. EPA has requested States to make nonattainment designation recommendations by February 2004 and is expected to make official designation determinations by December 2004. The States then will have until February 2007 to prepare or revise PM SIPs.

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The Basics About the JOINT STRIKE FIGHTER

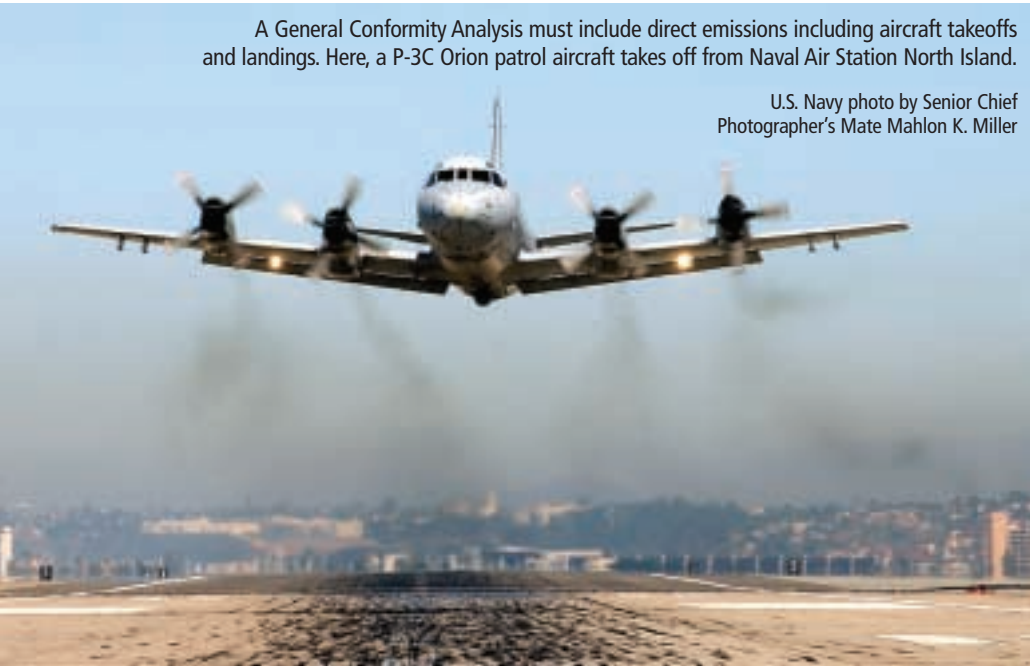
The JSF is the largest weapon system acquisition in the history of the Department of Defense (DoD). The Program involves the purchase of approximately 2,600 new aircraft, most of which will be based in the United States. The JSF Program involves the replacement of current fighter aircraft for the U.S. Air Force, Navy, and Marine Corps. Legacy aircraft being considered for replacement by the JSF (or F-35 aircraft) are:

- Air Force F-16C and A-10,
- Navy and Marine Corps F/A-18C/D, and
- Marine Corps AV-8B.

Legacy aircraft are currently based at over 60 installations in the United States. There will be three different variants of the JSF to accommodate different missions:

- The Conventional Take-Off and Landing (CTOL) variant for the Air Force,
- The Navy Carrier variant (CV), and
- The Marine Corps variant for Short Take-Off and Vertical Landing (STOVL).

The JSF has greater operational capabilities than the legacy aircraft it will replace. Its engine can achieve higher combustion temperatures and is more efficient. Because of a greater dry thrust to weight ratio and lower drag due to the lack of external tanks or weapons, the JSF can climb above the 3,000-foot elevation faster, thereby spending less time in the ground level mixing layer than legacy aircraft. [NOTE: The ground level mixing layer is the space between the ground and a 3,000-foot ceiling. Above that 3,000-foot ceiling, the prevailing wind currents are thought to move pollutants away from the affected air district.]



A General Conformity Analysis must include direct emissions including aircraft takeoffs and landings. Here, a P-3C Orion patrol aircraft takes off from Naval Air Station North Island.

U.S. Navy photo by Senior Chief Photographer's Mate Mahlon K. Miller

The 8-hour ozone implementation schedule is somewhat different. [NOTE: This standard is named after the 8-hour monitoring period required to demonstrate compliance with the standard.] States were required to make recommendations by July 2003 and EPA was to have finalized the designations by April 2004. This was to have taken place after the implementation plan for the 8-hour ozone standard had been finalized (which was due in December 2003). The implementation requirements have yet to be finalized. Assuming EPA finalizes nonattainment designations on schedule, States will have until April 2007 to prepare the 8-hour ozone SIPs. From the General Conformity perspective, how areas are designated determines the de minimis thresholds and will make a huge difference on the actions that will require a General Conformity Analysis.

Deployment of the JSF is not anticipated until 2008. In the interim, all non-attainment areas will be revising their SIPs as the move toward attainment (and go into maintenance status), or establish a SIP budget to comply with either the PM or 8-hour ozone NAAQS. The plan, therefore, is to include estimates of JSF emissions in the SIP budgets as they are revised. By doing so, a General Conformity Analysis will not be required. If the program waits until all emission data become available, the SIP budgets will already be set and the entire analysis will be much more difficult.

Modeling Emissions Estimates

At the present time, there is not enough information to project anything but notional construction and indirect emissions associated with the JSF. For the most part, the JSF will be replacing existing aircraft, so it is expected that there will be no net increase or decrease in indirect emissions. Because the JSF has the ability to be started by an integrated power package, it is likely that the need for jet engine starts using GSE units will be greatly reduced or eliminated. Therefore, the GSE requirement will most likely be no greater than (and should be less than) for legacy aircraft. It is anticipated that there will be some minor maintenance in-frame engine testing, but these tests will be conducted at low power because the aircraft is not designed to be restrained at high thrust settings. As a result, the emissions estimates prepared to date only include aircraft operations emissions estimates and some in-frame maintenance testing.

The Components of a General Conformity Analysis

A General Conformity Analysis requires that both direct and indirect emissions be considered in the analysis. These emissions include the following sources:

Direct Emissions	Indirect Emissions
■ Aircraft operations	■ Emissions associated with new workers vehicle commute
■ Refueling operations	■ Related activity in a neighboring area
■ Testing and maintenance	■ New infrastructure that will be required
■ Ground support equipment	
■ Construction activities	

There are three main components that go into estimating aircraft operation emissions:

1. Emission indexes (EIs) from engine tests,
2. Fuel flows and times in mode from test and/or simulator flights, and
3. The number of landing and takeoffs necessary per year.

The current model assumes that the emissions are only a function of the fuel flow and uses an equation for emission index as a function of fuel flow. Initial estimates of emission indexes were based on EIs from similar engines scaled by fuel flow rates at rated power. As demonstrator engines are built and tested, new emissions data are made available and the EI equation is modified.

For modern high performance aircraft engines such as the F-135/F-136 used in the JSF, the Volatile Organic Compound (VOC) emissions are typically very low and are usually considerably lower than on legacy aircraft. Both VOC and carbon monoxide emissions are only an issue at low power settings typical during preflight checkout, taxiing, and hot refueling. Particulate emissions are primarily in the form of either unburned hydrocarbons or carbon particles. These particles are very fine and typically less than one micron in aerodynamic diameter.

Due to the cost and complication of taking PM measurements, they have been the most delayed data received and the least accurate measurements used in the model. Because of the large flow area required by the engine and the high velocities of the exhaust flow, there are no test cells that can strictly follow the EPA Method 5 requirements. Fortunately, PM emissions from high performance aircraft are relatively low and the impacts are not likely to trigger General Conformity in most cases.

Historically, legacy aircraft emissions estimates have been based on flight landings, takeoffs and flight operations. For a new aircraft as radically different in capabilities as the F-35, there are no historical data. It is also not accurate to assume that the JSF will have the same number of landings and takeoffs as legacy aircraft because there will be greater reliance on simulators for training and maintenance of flying proficiencies. As a result, the emissions model for the JSF is built from the ground up, using the planned training requirements to estimate the number of landings and takeoffs, and the time spent in the mixing layer. The emissions model calculates emissions on a per aircraft basis and for each type of squadron, and then multiplies by the number of aircraft for an overall base emissions estimate for aircraft operations.

The Value of a General Conformity Analysis: Understanding Emissions

The ability to estimate engine emissions improves during the process of weapon system development as the engine design process and characteristics of the engine are better understood. A General Conformity Analysis requires that both direct and indirect emissions be considered in the analysis and these emissions can be more accurately characterized as the support and deployment requirements are refined. As the program and propulsion system mature, the understanding of the emissions matures as well. Air quality issues along with other environmental considerations will be considered in the National Environmental Policy Act (NEPA) review process. By continually revising the emissions budgets throughout the JSF development program, the air quality impacts will already have been developed and documented, and can be used in the NEPA documentation. A General Conformity Analysis also allows deployment planners to get a snapshot of air quality impacts as the Services narrow down the bases being considered for deployment of the JSF. Using this approach, General Conformity should not be an onerous process for the military and could make the NEPA process much easier. A General Conformity Analysis also allows State air quality planners to properly balance the burdens of air quality regulations for their nonattainment areas. ⚓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