Understanding Airtanker Use in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module IR_015_WP

Topic:

Understanding Airtanker use in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module.

Purpose

This paper describes how IRS models the behavior of Large Airtankers, Single-Engine Airtankers (SEATS), and Aerial Scoopers in order to partially or fully contain a fire's perimeter.

Terms

Area of Interest - Area of Interest (AoI) is a set of FWAs included in an analysis, for which the user can build several alternatives. FWAs do not vary between alternatives, only between analyses. To try a different AoI (e.g. collection of FWAs), the user must create a new analysis with explicitly identified collection of FWAs. Fire Planning Unit (FPU) analyses supporting the national budget request must fit within one of the agreed-to 139 FPU boundaries. Analyses for other purposes (e.g. "what if's" for analyzing possible effectiveness improvements by changing which FWA's are in which FPU) do not have that restriction.

Fire Program Analysis System (FPA) - A common interagency decision support tool for wildland fire planning and budgeting. This tool enables wildland fire managers in the five federal land management agencies to plan jointly. FPA also encourages the nonfederal wildland fire partners' participation.

Fire Workload Area (FWA) - An area or areas within an FMU that share an attribute that distinguishes it from the rest of the FMU, e.g. roadless portions of an FMU for which access to fires is by aerial resources and/or ground, significantly different resource values or fire workload.

Travel Time Point (TTP) - A system-calculated or user-defined point the system uses to calculate Travel Time from a Dispatch Location to an FWA.

Background

During the 2000 fire season, a significant number of Large Airtankers became unavailable to FPUs on a day-to-day basis for initial response because they could not safely perform their missions. Before 2001, there were 48 Large Airtankers available for dispatch. Today there are approximately16 Large Airtankers available nationally.

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The use of Single Engine Airtankers (SEAT) and Aerial Scoopers (CL215 & CL415) in initial response has increased because there is a better understanding of when and where to effectively and efficiently use each of these fixed wing aircraft.

This paper does not discuss the effectiveness of aerial drops of retardant and/or water to contain fire spread, or to reduce the fire intensity level to improve ground force effectiveness. Instead, it focuses on how the FPA IRS module simulates the availability and behavior of Large Airtanker and Aerial Scooper drops of water and/or retardant when responding to a fire event during the initial attack phase of managing wildland fire. This process applies to any aerial drop by SEAT or helicopter with bucket and/or tank.

Discussion

IRS models how aerial drops of water and/or retardant by helicopters and/or fixed-wing aircraft help contain wildland fires. FPA models the extent to which fixed and/or rotor wing aircraft aerial drops contribute towards fire containment by modeling this behavior as if these aircraft build fireline. FPA measures their effectiveness in chains per hour per drop.

IRS models Large Airtanker behavior using a fleet of 16 to 20 Large Airtankers. FPA does not assign Large Airtankers to a specific Large Airtanker base. Instead, Large Airtankers end the day at their last loading location, unless the Predictive Service Group and/or Fire Managers request them to be at a different location the following day. Large Airtanker activity and location cannot be projected from day-to-day, so IRS uses the three Large Airtanker bases closest (in a straight line) to the Fire Workload Area (FWA) Travel Time Point (TTP) as part of the Large Airtanker Travel Time calculation. IRS calculates the Large Airtankers Travel Time by averaging the distance between the three closest bases and dividing that value by the Large Airtanker Producer Type Average Speed. The system adds the Travel Time to Dispatch Decision Delay and Resource Response Delay to produce the Large Airtanker Arrival Time. No more than three Large Airtankers are dispatched per day to an FPU regardless of the quantity defined in the FPUs Dispatch Logic. For each fire event occurring at Fire Dispatch Levels requesting Large Airtankers, there will be a draw made from a Large Airtanker availability distribution to determine if a Large Airtanker is available for that fire event. FPUs can use the same three Large Airtankers for all fire events per Day-of-Year per FPU, provided they are available.

IRS assumes that when helicopters and/or fixed-wing aircraft make aerial drops of water and/or retardant:

- Ground-based fire resources are already on the fire event before any aerial drops of water and/or retardant begin. No aerial drops of water or retardant will occur before fireline-ground based resources arrive at the fire event. An FPU’s Dispatch Logic must request fireline-building resources to arrive prior to the model simulating aerial drops. When FPUs request ground-based fire resources, but their calculated arrival time is later than the aerial resources, the model delays the aerial resources until ground-based fire resources arrive at the fire.

- Helicopters and fixed -wing aircraft can operate only during civil daylight hours. IRS calculates civil twilight using the Day-of-Year and the location of the FWA TTP as defined by the United States Naval Observatory. The model calculates civil daylight prior to dispatching the requested aerial fire resource to the fire event. IRS does not dispatch aerial fire resources to a fire event when they are unable to complete a drop prior to the end of civil daylight.

IRS calculates Large Airtanker reload time using the distance from the FWA TTP to the closest Large Airtanker Dispatch location, and adding the Dispatch Decision Delay and Resource Response Delay for the calculated reload time. Dispatch Decision Delay and Resource Response Delays represent the typical time for a Large Airtanker to enter the airport traffic pattern, land, taxi to the pit, reload with retardant, taxi to run way, and take off. See Large Airtanker Bases for a list of large airtanker locations.

FPUs enter SEAT and Aerial Scooper reload times into FPA based on their knowledge about the time needed to depart a fire, travel to a suitable refill site, load, and then return to the fire to make a drop.

Immediately following the calculated Arrival Time of an aircraft dropping fire resources, the drop will produce fireline at a rate of one chain per 100 gallons delivered. All drops last one minute regardless of the producer type's capacity for helicopters and fixed-wing aircraft. The amount of fireline that resources can construct per drop depends on these three factors:

- Gallons per load being carried,
- Surface fuel model, and
- Rate of spread for the fire receiving the drop.

IRS applies an effectiveness factor to some surface fuel model/rate of spread combinations in order to understand the potential fireline that could be produced. The effectiveness factor is a reduction in fireline containment due to retardant not reaching the ground because of the canopy cover or a variable rate of spread. This reduction in the effectiveness factor continues as the rate of spread increases. Eventually, the rate of spread increases sufficiently to cause the retardant to become ineffective. This effectiveness factor applies even with ground-based fire resources building fireline on the fire event. See Airtanker Fireline Production further information.

See Also

- Understanding Helicopter Use in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module IR_006_WP
- Understanding Preproduction Delays in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module IR_005_WP
- Understanding Delays in Fire Program Analysis (FPA) Initial Response Simulation (IRS) Module IR_009_WP

Appendix: Airtanker Fireline Production

Aerial Drop Effectiveness Algorithm

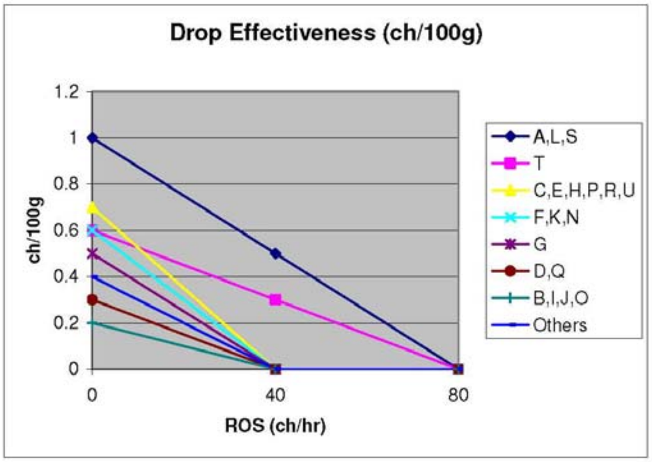
The original aerial drop effectiveness algorithm included a set of linear functions – one for each of several groupings of NFDRS fuel models. Each function had "full effectiveness" when the rate-of-spread (ROS) was zero, and declined to no effectiveness when the ROS was 40 ch/hr or above.

In order to model effectiveness of drops at higher rates-of-spread in grass fuels, the model was subsequently modified to indicate that fuel models A, L, S, and T "zeroed out" at 80 ch/hr instead of 40.

The "full effectiveness", in chains produced by fuel model, was not changed as part of this modification. That effectiveness is shown below:

Fuel Model	Ch/100gal
A,L,S	1
T	0.6
C,E,H,P,R,U	0.7
F,K,N	0.6
G	0.5
D,Q	0.3
B,I,J,O	0.2
Others	0.4

A chart summarizing the effectiveness, as a function of ROS and Fuel Model follows:



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