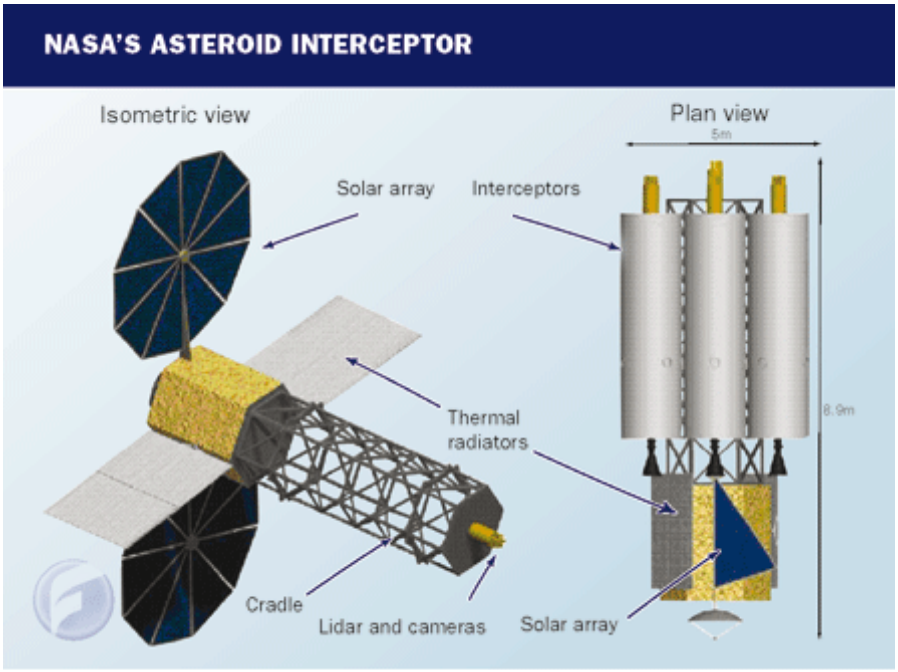
NASA plans 'Armageddon' spacecraft to blast asteroid

By Rob Coppinger

NASA's Marshall Space Flight Center has designed a nuclear-warhead-carrying spacecraft, to be launched by the US agency's proposed 's Ares V cargo launch vehicle, to deflect an asteroid that could threaten all life on Earth.

The 8.9m (29ft)-long "Cradle" spacecraft would carry six 1,500kg (3,300lb) missile-like interceptor vehicles that would carry one 1.2MT B83 nuclear warhead each, with a total mass of 11,035kg.

Launched by an Ares V, the spacecraft would leave low-Earth orbit using a 45,359kg liquid-oxygen/liquid-hydrogen fuelled "kick stage".



The spacecraft's target near-Earth object (NEO) is the Apophis asteroid, which will pass by the Earth within the orbit of the Moon in April 2029. For the study, however, its orbit was changed to bring it into a "dead-centre" collision course with Earth and its mass was assumed to be 1,000,000kg. The spacecraft's possible launch dates were 2020 and 2021.

By the 2020s NASA concluded that "the nuclear interceptor option can deflect NEOs of [100-500m diameter] two years before impact, and larger NEOs with at least five years warning".

The Cradle would have solar arrays, radiators, a light detection and ranging (lidar) instrument, a set of wide and narrow field of view (W/NFOV) cameras for guidance, a reaction control system and an avionics and communications package.

Each interceptor vehicle, with a terminal rendezvous package (TRP), would have a hydrazine-fuelled engine, a nitrogen tetroxide reaction control system and a lidar, and W/NFOV cameras for guidance.

The first vehicle/TRP could be launched, for a stand-off detonation near the NEO, 5h before the last interceptor's release, or the six TRPs could arrive at 1h intervals where the Cradle is 100h from intercept.

The warheads would explode at a distance of one-third of the NEO's diameter and each detonation's X and gamma rays and neutrons would turn part of the NEO's surface into an expanding plasma to generate a force to deflect the asteroid.

"The Hollywood scenario solution of shooting several intercontinental ballistic missiles at the incoming rock is fraught with danger. It probably would not be sufficient to prevent impact, raising the additional hazard of radioactive materials from the blast being introduced into the atmosphere," says the report.

A kinetic "bullet" version would use this interceptor design, but have an inert warhead instead of a nuclear one. In both cases the lidar would acquire the target NEO at 5,000km (3,100 miles) distance, with TRP closing velocities of up to 10,000m/s (1,968,503ft/min).

The Marshall study also has a solar collector option that has a very different vehicle design to the warhead and kinetic vehicles. The collector, which is more like an orbiter probe, would maintain station near the NEO and use a 100m-diameter inflatable parabolic collector membrane to focus sunlight into a "thruster" that directs that energy on to the NEO's surface. The heating of surface material evaporates it generating thrust and deflection.

But before the solar, nuclear or kinetic missile-carrying spacecraft is launched, NASA concludes that a precursor mission is needed and would send a 1,500kg observer spacecraft to the asteroid to determine its composition.

Knowing its composition would help the agency determine if a solar, kinetic or nuclear spacecraft would have to be sent.

NASA's proposed Ares I crew launch vehicle would loft the 23,316kg, 14m-long, observer stack, consisting of a liquid-oxygen/liquid-hydrogen-fuelled RL-10 B-2 engine-powered "trans-asteroid insertion stage", a second bi-propellant rendezvous stage, and the spacecraft, into LEO.

The observer spacecraft would be based on the probe built for NASA's 2005 Comet encounter Deep Impact mission, using some of its payload instruments.

For its instruments, which include a laser range finder and a radar, the observer's main power source would be a radioisotope thermal generator. It would also carry a Lander and a box launcher for seismic impactors and gravity fly-by projectiles.

The Lander would have a constant thrust motor to keep it in contact with the NEO's surface in the low-gravity environment and have three seismic sensors on the end of three long legs with surface penetrating spikes. The seismic sensors would detect the effect of the observer's impactors' arrival.