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**North Korean Long-Range Ballistic Missiles and US Missile Defenses**

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On Tuesday, November 28, 2017, North Korea launched a missile called the Hwasong-15, which shows astonishing technological advances relative to earlier long-range North Korean missiles.The first stage of the Hwasong-15 uses a full RD-250 rocket motor unit with a single turbopump driving two thrust chambers giving a sea-level thrust of about 80 tons.This and related rocket motors were almost certainly obtained from Russian or Ukrainian sources.The motors on the first stage are mounted on gimbals, which eliminates the need for vernier control engines.This innovation both increases the overall reliability of the missile and frees up weight for the final payload.The second stage uses a high-performance rocket motor that has not been seen before in North Korean missiles.The characteristics of the second stage closely match those of the second stage of the Soviet ICBM known in the West as the SS-11, which was built in very large numbers during the early part of the Cold War.This talk explains how the North Korean liquid propellant ballistic missile program has been able to advance from its earliest days at an unprecedented rate.The program has received almost certainly without the knowledge of the Russian government large amounts of rocket components and expertise, starting from the time of the catastrophic collapse of the Soviet Union and its economy.Another feature of the North Korean program is the startling level of indigenous innovation demonstrated in North Korean ballistic missile designs, which very cleverly use rocket components that were intended for other purposes.This talk will also briefly introduce a missile defense concept that could potentially allow the US to destroy North Korean ICBM-range ballistic missiles while they are in powered flight.Unlike the current Ground-Based Missile Defense (GMD) this defense can be built with existing demonstrated technologies and does not require violation of fundamental physical principles to work.