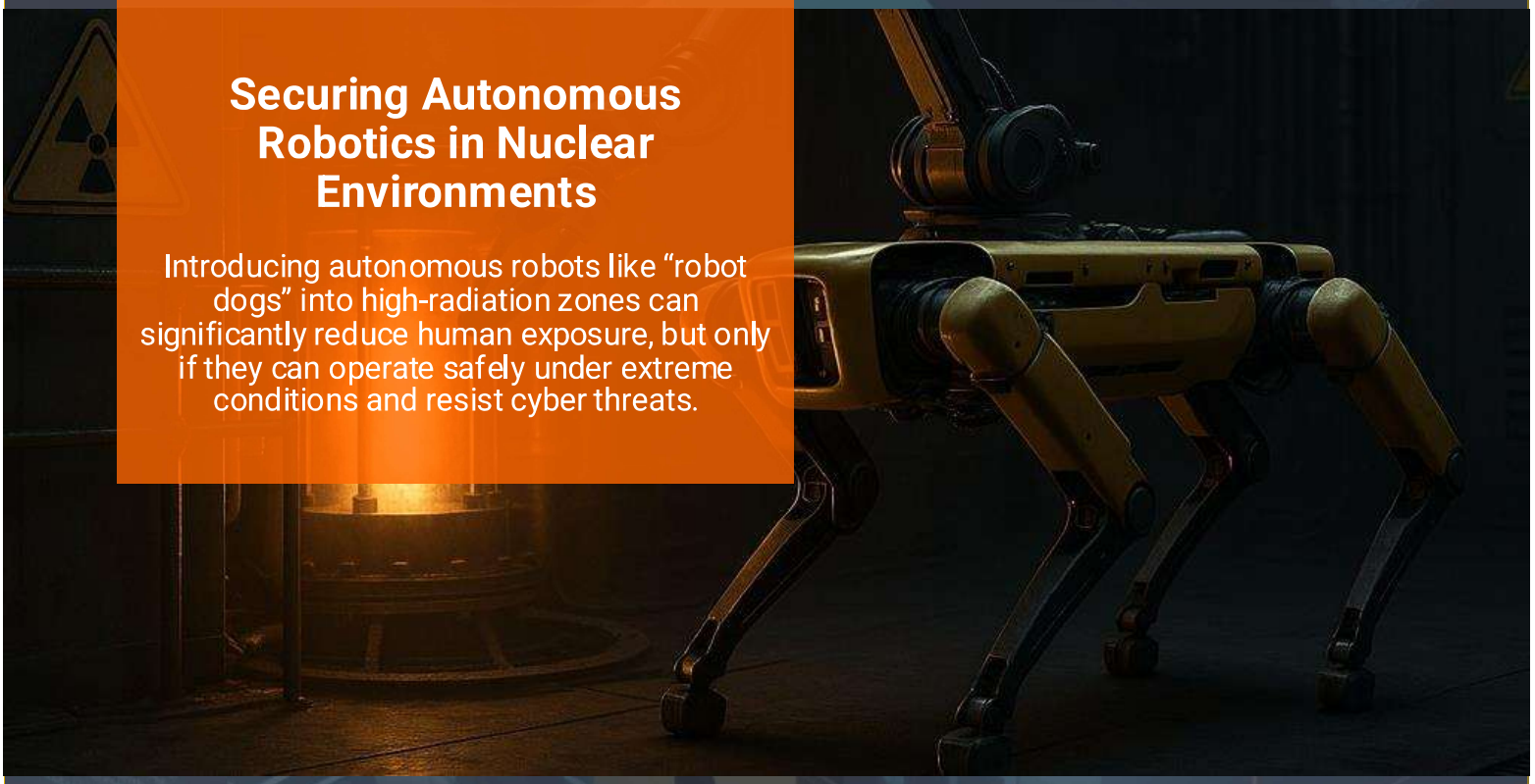
Agile Robotic Quadruped case study

PRO CYBER SECURITY

Securing Autonomous Robotics in Nuclear Environments

Introducing autonomous robots like “robot dogs” into high-radiation zones can significantly reduce human exposure, but only if they can operate safely under extreme conditions and resist cyber threats.



Situation

A high-hazard nuclear facility sought to reduce human exposure during legacy waste retrieval operations. A robotic quadruped ("robot dog") was proposed to perform reconnaissance and light manipulation tasks in radioactive zones. Before deployment, a rigorous risk assessment and substantiation process was required to ensure the robot’s safety, reliability, and regulatory compliance.

Task

To identify and mitigate operational risks using system-theoretic and probabilistic methods, and to confirm the robot dog’s ability to operate safely and effectively in a high-radiation environment.

Activity

Our OT/ICS cyber security experts: applied STPA to define loss scenarios and constraints; used Monte Carlo simulation to quantify risk, tested cyber resilience through a hybrid physical-virtual digital twin, and compiled the results into risk balance case for stakeholder approval.

Result

We delivered a cyber security risk balance case underpinned by a digital twin substation of key risks and associated mis-use cases; to ensure the robot fails safe in the event of a hostile cyber attack - protecting safety of the workforce and systems.

Keywords: NISR, ONR SyAPs, STPA, Monte Carlo, NIST, OT/ICS, Robotics, Civil Nuclear