

## Game Design Challenge Finalist Team 3061

**Team Name:** Huskie Robotics

**Location:** Naperville, Illinois USA

**Game Name:** Operation Radiation

### **Game Overview:**

FIRST City's state-of-the-art nuclear power plant has been compromised by a cyber-attack. Thankfully, the plant's original designers prepared for this scenario, therefore all systems can be manually controlled. To address this impending energy crisis, FIRST Engineers have a mission: Operation Radiation. To restore safe energy production, robots deposit fuel rods into enclosures for decontamination. The cyber-attack has also disabled some of the plant's cooling systems requiring robots to circulate coolant to lower the plant's temperature and keep enclosures operational.

Robots start on their respective initiation lines, opposite their alliance station wall. During a 15 second autonomous period, alliances deposit spent fuel rods into Enclosure 3 and score coolant to earn points and lower the plant's temperature. At the outset of teleop, Enclosure 3 overheats and only Enclosure 1 is accessible. During teleop, robots continue to score fuel rods and coolant.

In Operation Radiation, enclosures are the main field element. Enclosures can contain 10 fuel rods but after 5 fuel rods have been deposited, alliances earn half as many points for subsequent rods. At any time, alliances may initiate the decontamination process, a 20 second period (specific to each enclosure) during which additional rods cannot be scored. Human players initiate decontamination by pressing each enclosure's respective decontamination button. Alliances earn points for each rod at the end of the decontamination process.

Coolant can be scored in four different locations: a lower pipe, an upper pipe, and two small pipes. Alliances earn 1 point for every coolant scored in the lower and upper pipes and 2 points per coolant scored in the small pipes. Different pipes lower the temperature of the plant at different rates. Alliances must score 3 coolant in the lower pipe or 2 in the small or upper pipes to lower the temperature 1 degree. Enclosure 1 is open during all of teleop, but to activate Enclosure 2, alliances must lower the plant's temperature by 4 degrees. For Enclosure 3, 10 total degrees are required.

Alliances earn 4 points for each rod scored in Enclosures 1 and 2 for the first five rods, and earn 2 points for additional rods scored up to capacity. Enclosure 3 offers alliances 6 points per rod for the first five, and 3 points per additional rod— up to capacity. Teams may fill and decontaminate active enclosures in any order. After decontamination starts, human players empty enclosures for reuse.

During the endgame, teams race to their evacuation point to be lifted to a low-radiation plant sector. The evacuation point is a climbing apparatus composed of a single chain that slides as weight is applied. Robots parked in the evacuation zone at the end of match time earn 5 points, whilst hanging robots earn 20 points. Additionally, a robot who lifts itself to 18" or above and maintains this position for 5 seconds following match end will earn 10 more points.

To protect the powerplant and save FIRST City, we must count on FIRST engineers to ensure a new tomorrow. Operation Radiation is a GO!

### **Describe Notable Field Elements:**

Operation Radiation incorporates a diverse array of challenges that call for a dynamic set of field elements. The field features two walls of pipes, six total decontamination enclosures, two endgame evacuation points, and two loading stations. These field elements make the game accessible to alliances of all experience levels while simultaneously promoting audience engagement.



The primary game pieces in Operation Radiation are fuel rods. Fuel rods are 18" long, 1.5" diameter white PVC pipes. To score fuel rods, teams utilize their three decontamination enclosures, 36"x24"x30" receptacles, with front and top facing rectangular openings for fuel rod intake. The front facing opening of each enclosure is at the same height as the loading station. The enclosures' size and centralized field placement provide a clear line of sight for audience members.

Coolant Pipes serve as Operation Radiation's secondary field element. 30" and 24" diameter pipes centered 7' and 2' off the playing surface respectively make up the upper and lower pipes. Two smaller 12" pipes, offset 12" from the center, stand 5' above the ground. All pipes are situated at a 30° angle relative to the alliance station wall, increasing the range where robots can score coolant— which are 5" diameter blue gator skin balls.

Two evacuation points are located at the middle of the field. Each contains three posts, standing 82" tall and positioned at the vertices of an 8' equilateral triangle. A horizontal, continuous chain passes through these posts. Robots climb the chain to evacuate the area at the end of the match.

Featuring an open field layout and a versatile collection of scoring opportunities, the Operation Radiation field combines popular characteristics of previous FRC games with new twists to create an engaging experience for all.

### **What are robots expected to do?**

Operation Radiation allows teams of any ability the opportunity to influence matchplay. The field elements, game pieces, and game rules facilitate a number of potential strategies that will imbue each match with its own unique flair.

During matchplay, alliances balance the scoring of point-dense fuel rods with the advantage of opening more enclosures by scoring coolant. Given each enclosure's 20 second decontamination period, alliances will likely need to score coolant and open their second enclosure early in the game. Likewise, if alliances intend to open Enclosure 3, they must continue to prioritize scoring coolant.

Autonomous presents teams with two temporary advantages: double points for scoring coolant, and access to Enclosure 3. Alliance makeup may affect how teams coordinate their actions during autonomous and ultimately decide which game strategy they elect to pursue. For example, some alliances may focus on scoring coolant to prepare for teleop while others might choose to exploit the point-dense

Enclosure 3 to gain an early scoreboard advantage.

Endgame presents a variety of complex scenarios to alliances. Consistent climbing will likely be a ubiquitous skill among teams who compete in playoff matches given its point density. Alliances may also coordinate climbs to maximize the number of robots that earn the height bonus.

Operation Radiation is designed such that many teams are likely to specialize in scoring either coolant or fuel rods. Teams eyeing higher seeds for elimination rounds will be capable of scoring both. These teams will be distinguished by their efficiency of scoring both game pieces.

Operation Radiation's rules, point structure, and field design provide a basic framework of robot action; however, the number of potential robot designs, strategies, and alliance makeups lead to exciting, varied gameplay for both teams and spectators.

### **Did you use the Game Design Challenge Element in your concept?**

Yes

If yes, how?

Operation Radiation employs the chain ELEMENT within the Evacuation Point, an unorthodox climbing apparatus for endgame. The chain, a 26' loop, passes through three openings in the posts located 6.5' above the ground in the shape of an 8' equilateral triangle. It is free to slide between these openings. The length of the chain provides ample slack as it travels between each vertex of the triangle, a unique and unpredictable challenge to alliances that promotes collaboration.

Due to its length, the height at the chain's bottom varies according to the applied tension. All three segments begin at a height of ~5'. If only one side of the chain is under tension, that segment will lower to 3.5' above ground, while the remaining two sides will be pulled taut at 6.5'. If two sides are under tension, the respective segments will sag to ~4.5' above ground while the third side remains taut at 6.5'. Finally, if all three sides are under tension, each side will remain at ~5'.

The varying chain height offers many differing endgame scenarios for teams to encounter. Depending on the sequence of climbing, robots must be able to climb at varying heights. Additionally, alliances earn points for each robot that climbs 18" above ground and holds this position for 5 seconds post-match. This incentive provides a bonus for robots that are able to go above and beyond the challenge presented by simply rising off the ground. The difficulty of achieving this height alone also compels teams to work together and spend more time coordinating endgame play to maximize the ending height of all climbing robots.

This exciting addition to Operation Radiation ensures action and audience engagement for the entire match. The possibilities are endless as robots race to evacuate.