



RAD to the Core!

BEST 2001 Design Contest

THE RULES

RAD to the Core

Alarms bells ringing and red lights flashing were our first clue that something was wrong.

We had just been talking to a technician and now she was gone. Then I thought, “In a nuclear power plant, people disappearing, alarms sounding, red lights flashing, that can’t be good!” We were only here to demonstrate two new RAD. (Robot Assisted Delivery) robots from BEST robotics Inc. They could crawl along the overhead beams and do routine maintenance work. Finding ourselves in the middle of a nuclear accident was more than we bargained for.

Looking through the thick glass into the reactor room we spotted the missing control room nuclear technician standing by one of the two reactors frantically waving at us. Through the intercom we could just barely hear her above the din of the alarms. “The control rod system has failed and the reactors are beginning to overheat. Can your robots remove the fuel rods?”

We looked at each other and said, “What’s a fuel rod?” Figuring our robots could do darn near anything we shouted back “Sure, we do it all the time! We just can’t remember which are the fuel rods” This seemed to upset her for some reason and she shouted back from the reactor room floor, “Just use your robots to remove what I point to, then put them in a MTCV.” We looked at each other and said “MTCV?”, both of us shrugged our shoulders”. So I shouted back “Uh,, our MTCV is in the shop right now.” I guess she forgot my name because she shouted back “listen numbskull, the MTCV is the Multi Tube Containment Vessel right over there”. We could see where she was pointing and to show her we understood, we used our arms to make each letter MTCV while singing YMCA. For some reason she threw a heavy wrench at us. We didn’t need it and the thick glass keep us from catching it anyway, she must have forgotten about that.

Pulling up a chair we popped open a soft drink and opened up the RAD instruction books. Another wrench bounced off the glass. Figuring she wanted to see us dance MTCV again we stood up and began making the arm motions. Over the intercom I heard her shout “Hey Birdbrains (We really need to give her one of our cards) we only have 3 minutes to live if these reactors are not shutdown.” We decided we would finish our drinks later. “Make your robots hit the emergency cooling switch first, that will give us more time,” she said while pointing across the reactor room to a button underneath a flashing red light.

Okay we had it down now. First drive over and hit the emergency cooling switch, then remove the fuel rods and put them in the MTCV. We can do that! If we work together we can shutdown those reactors quick, fast and in a hurry. It was time to take RAD to the Core! We began to feel so good about this we started doing our MTCV dance again. Hey look, she found another wrench.

1.0 Objective

The objective is to design and build a remotely controlled device which runs on an overhead track and removes fuel rods from nuclear reactors, placing them into Multi-Tube Containment Vessels (MTCV).

1.1 Field

The playing field is rectangular, 12 feet wide and 48 feet long (see diagram further on). Each machine is suspended from an inverted “T” track. (Note that this track may not be perfectly straight and may sag.) Each half of the field has two parallel tracks on 4 foot centers, for a total of four tracks.

Between the two tracks on each half of the field are two nuclear reactors. Each reactor has 6 fuel positions, 3 for each team on that side of the field. At the start of the game each position will contain a fuel rod, with the hinged radiation shield passing through its handle.

In the center of the field are 4 Multi-Tube Containment Vessels, one for each team.

The fuel rods are all the same. Scoring is based on the absence of fuel rods in the reactors and their presence in the MTCV’s. Fuel rods which fall on the carpet are still in play and may be picked up. Fuel rods which touch the ground outside the carpeted area are out of play.

Machines must remain on their track, although parts may be detached and placed on the reactors, MTCVs, or carpet. Machines may not drive on the carpet.

1.2 Starting Locations

Before the start of a match your machine must be within the colored 24 inch starting zone at the start of your track. It may face any direction. Your driver and one spotter will be in their respective areas.

1.3 Match Play

When the match starts, the four teams have 3 minutes to remove as many fuel rods as possible from the reactors and to place them into their MTCV’s. The fuel rods are considered removed from reactors when they are completely clear of the reactor tube and the hinged radiation shield closes. Reopening the radiation shield does not affect the score. Fuel rods are considered in an MTCV if they are at the maximum possible insertion depth (i.e., touching the bottom).

On each track, in the center of the field, is an Emergency Cooling Switch. To score points a team must trip their Emergency Cooling Switch at some time during the round. Interfering with your opponents’ tripping of their switch is not allowed and will result in the blocking team’s machine being disabled for the remainder of the round.

1.4 Scoring

At the end of each match points are awarded to each team as follows:

No points are scored unless the team’s Emergency Cooling Switch is tripped before the end of the round. If it is tripped, then they score:

1 point for each of the team’s fuel positions in a reactor which does not contain a fuel rod. It does not matter which team removed the fuel rod.

2 points for each tube of the team’s MTCV which does contain a fuel rod. It does not matter from which reactor position the fuel rod originated or which team placed the fuel rod into the MTCV. Tubes with more than one fuel rod still only count 2 points.

For each reactor that is completely shut down – all 6 fuel rods removed – the points in both MTCV’s on that half of the field are doubled (but not the points for fuel rods removed from the reactors). If *both* reactors on the same side of the field are shut down, MTCV points (only) are doubled again.

2.0 Competition Protocol

There will be two phases to the contest, a partial round robin preliminary competition and a three game round robin playoff between the top scoring four teams.

During the preliminary competition each machine will play eight games against randomly selected opponents. Teams will be ranked by their average score from all their preliminary games.

Ties will be resolved by the order in which teams closed their Emergency Cooling Switch (on average). A lower number (faster) is better. If there is still a tie straddling positions four and five after this tie breaker, the total number of MTCV positions filled by each team in their eight preliminary games will be used to resolve it. If this does not resolve the tie, the tied machines will each play a round on their own (the only machine on their side) while the referees time how long it takes each to close their Emergency Cooling Switch. Highest score wins, with ties here resolved in favor of the machine fastest at closing their switch.

Once all teams have played eight matches, the top four machines will compete for the top four places. Each team will be paired with each of the other three teams once. The final ranking of the four teams will be determined by the teams’ total scores for these three games. In case of a point tie, teams will be ranked by the order in which they tripped their emergency cooling switches in the third game. In tabular form, for teams 1 thru 4:

Track Color			
Red	Green	Blue	Yellow
1	2	3	4
4	1	2	3
1	3	4	2

Every effort will be made by the organizers to have 4 teams play in each game during the day. Due to circumstances beyond our control (such as “no-shows” or damaged machines) it may be necessary to play some games with less than 4 machines on the field. The bonuses for clearing reactors still apply, but teams on a side by themselves will have to do extra work to earn the bonus. (Note that this is no different than being paired with a “scoring challenged” machine.)