1992: The Emergency Power-Restoration Problem

Power companies serving coastal regions must have emergency-response systems for power outages due to storms. Such systems require the input of data that allow the time and cost required for restoration to be estimated and the "value" of the outage judged by objective criteria. In the past, Hypothetical Electric Company (HECO) has been criticized in the media for its lack of a prioritization scheme.

You are a consultant to HECO power company. HECO possesses a computerized database with real-time access to service calls that currently require the information:

- time of report,
- type of requestor,
- estimated number of people affected, and
- location (x, y).

Crew sites are located at coordinates $(0, 0)$ and $(40, 40)$, where x and y are in miles. The region serviced by HECO is within $-65 < x < 65$ and $-50 < y < 50$. The region is largely metropolitan with an excellent road network. Crews must return to their dispatch site only at the beginning and end of shift. Company policy requires that no work be initiated until the storm leaves the area, unless the facility is a commuter railroad or hospital, which may be processed immediately if crews are available.

HECO has hired you to develop the objective criteria and schedule the work for the storm restoration requirements listed in **Table 1** using the work force described in **Table 2**. Note that the first call was received at 4:20 A.M. and that the storm left the area at 6:00 A.M. Also note that many outages were not reported until much later in the day.

HECO has asked for a technical report for their purposes and an "executive summary" in laymen's terms that can be presented to the media. Further, they would like recommendations for the future. To determine your prioritized scheduling system, you will have to make additional assumptions. Detail those assumptions. In the future, you may desire additional data. If so, detail the information desired.

Table 1.

Storm restoration requirements.

Time (A.M.)	Location	Type	# Affected	Estimated Repair Time (hrs for crew)
4:20	$(-10, 30)$	Business (cable TV)	?	6
5:30	$(3, 3)$	Residential	20	7
5:35	$(20, 5)$	Business (hospital)	240	8
5:55	$(-10, 5)$	Business (railroad sys.)	25 workers; 75,000 commuters	5
6:00	All-clear given; storm leaves area; crews can be dispatched			
6:05	$(13, 30)$	Residential	45	2
6:06	$(5, 20)$	Area*	2000	7
6:08	$(60, 45)$	Residential	?	9
6:09	$(1, 10)$	Government (city hall)	?	7
6:15	$(5, 20)$	Business (shopping mall)	200 workers	5
6:20	$(5, -25)$	Government (fire dept.)	15 workers	3
6:20	$(12, 18)$	Residential	350	6
6:22	$(7, 10)$	Area*	400	12
6:25	$(-1, 19)$	Industry (newspaper co.)	190	10
6:40	$(-20, -19)$	Industry (factory)	395	7
6:55	$(-1, 30)$	Area*	?	6
7:00	$(-20, 30)$	Government (high school)	1200 students	3
7:00	$(40, 20)$	Government (elementary school)	1700	?
7:00	$(7, -20)$	Business (restaurant)	25	12
7:00	$(8, -23)$	Government (police station & jail)	125	7
7:05	$(25, 15)$	Government (elementary school)	1900	5
7:10	$(-10, -10)$	Residential	?	9
7:10	$(-1, 2)$	Government (college)	3000	8
7:10	$(8, -25)$	Industry (computer manuf.)	450 workers	5
7:10	$(18, 55)$	Residential	350	10
7:20	$(7, 35)$	Area*	400	9
7:45	$(20, 0)$	Residential	800	5
7:50	$(-6, 30)$	Business (hospital)	300	5
8:15	$(0, 40)$	Business (several stores)	50	6
8:20	$(15, -25)$	Government (traffic lights)	?	3
8:35	$(-20, -35)$	Business (bank)	20	5
8:50	$(47, 30)$	Residential	40	?
9:50	$(55, 50)$	Residential	?	12
10:30	$(-18, -35)$	Residential	10	10
10:30	$(-1, 50)$	Business (civic center)	150	5
10:35	$(-7, -8)$	Business (airport)	350 workers	4
10:50	$(5, -25)$	Government (fire dept.)	15	5
11:30	$(8, 20)$	Area*	300	12

*Area signifies a combination of two or more of the other classification types.

Table 2.
Crew descriptions.

- Dispatch locations at $(0, 0)$ and $(40, 40)$.
- Crews consist of three trained workers.
- Crews report to the dispatch location only at the beginning and end of their shifts.
- One crew is scheduled for duty at all times on jobs assigned to each dispatch location. These crews would normally be performing routine assignments. Until the "storm leaves the area," they can be dispatched for "emergencies" only.
- Crews work 8-hr shifts.
- There are six crew teams available at each location.
- Crews can work only one overtime shift in a work day and receive time-and-a-half for overtime.