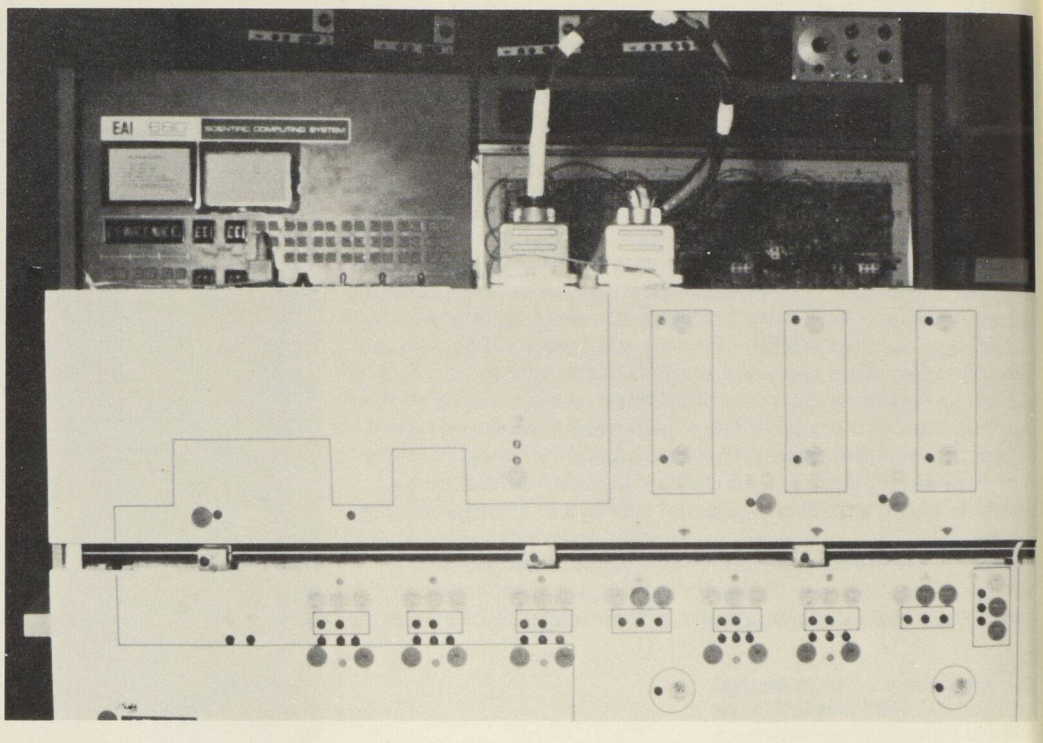
The display unit. Crane positions are reflected by the servo-operated models, and stages in the smelting process by color-coded lights.



the components of the smelter plant. As has been mentioned earlier, the method by which a converter foreman arrives at his decisions is not readily amenable to computer simulation — equations that adequately represent the interplay between experience, observation and intuition have yet to be written.

The two NRC researchers concluded that the most satisfactory answer to this problem was to use a "real" human operator — in fact a converter-foreman to operate the model, and from the man-computer interaction build up a repertoire of decision-making processes. To this end, in addition to the conventional teletype input / output unit, a special display unit based on the floor plan of the smelter plant (complete with servo-operated models of the overhead cranes) was added to this system. Not only did this on-line display unit provide valuable insight into crane scheduling and interference problems, but also, as Mr. Nenonen remarks, overcame "the communication barrier normally encountered between computer models and operating personnel." The display panel provides information on the status of all the components of the system via an array of color-coded indicator lamps, and a digital readout of the simulation time in hours and minutes. This display unit proved to be an invaluable tool in the development of the simulation model.

Only a brief orientation period was required before smelter operating personnel were able not only to run the "hypothetical" smelter as confidently as the real thing, but also to provide suggestions on model improvements based on the information they received from the display unit. This form of display unit removes the need for the operator to acquire any programming knowledge. He can, instead, concentrate his attention on the actual operation of the model.

With the development of the model to the stage of simulating actual production runs, possibilities for increased productivity through rescheduling began to emerge. One particular example was the established policy of material transfer between any two converters part-way through the conversion process. This procedure had been followed in order that one converter could, after only a short matte processing time, proceed to a copper blow, while the other converter reverted to the initial matte phase. In addition, it was thought that this would allow the end points of the batch converter processes to be evenly distributed. Results of many simulation runs, however, revealed that by opting for a "no transfer" policy, overall smelter production could be increased by up to seven per cent. Application of the "no transfer" policy also facilitated a more even distribution of the converters' end points.

Rescheduling crane maintenance periods, investigating the use of oxygen enriched air in the conversion process and studying the effects of the construction of a new continuous smelting unit on converter aisle operations are further valuable applications of the computer model. The potential and proven benefits from the application of such computer models can amount to millions of dollars per annum. Perhaps the greatest value of the model lies not simply in the potential direct economic gain, but in its use as a training aid. Apart from being able to provide a new foreman with experience in spacing different blowing stages on the converters, scheduling cranes and refining and casting operations, the model can be of great value to an experienced foreman who wishes to try out new policies without the risk of disrupting production.

NRC's success with this hybrid computer-based simulation has led to a cooperative program between the Steel Company of Canada and NRC's Division of Mechanical Engineering to develop a computer model of that company's oxygen furnace plant in Halifax. Also work is under way on the modelling of an electric furnace plant run by Quebec Iron and Titanium.

A key feature in the successful development of this type of computer model has been the involvement of plant operating personnel from the early stages of the program. In a very real sense, the copper smelter model was "designed around" the person of the converter foreman, supplementing rather than supplanting his role, the machine being made to adapt to the man. This points up an important fact which is too often forgotten when the role of the computer in human activities comes under consideration. These "big, fast, dumb adding machines" can do much more than relieve humankind of the drudgery of repetitive calculational tasks — properly used they offer great potential for extending and enhancing our own abilities. □ **David Mosey**