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IMPLEMENTING THE IEEE CODE OF ETHICS

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On November 18, 1977, in San Diego, the IEEE Board of Directors (BOD) heard presentations on two different proposals for setting up procedures to implement the IEEE Code of Ethics. The BOD discussed the proposals at some length and then voted 15-5 to table the matter.

One presentation was by Walter Elden, representing the USAB Ethical Conduct Task Force, which is chaired by Stephen Kowel. He outlined the recommendations of that group for an IEEE Ethics Committee that would have the dual purpose of assisting engineers whose careers were jeopardized because of their adherence to the code of ethics (support) and investigating charges of infractions of the ethics code by IEEE members (enforcement). [A preliminary draft of this proposal appeared in the September issue of T & S.] The second proposal, presented by James Fairman, described procedures for handling a broader spectrum of charges against IEEE members that includes, but is not limited to, violations of the ethics code. This proposal deals only with enforcement—not with support. It was generated by an independent committee, appointed by the BOD and chaired by Mr. Fairman.

The two proposals were not coordinated, and confusion among board members as to how they could best be intermeshed was apparently instrumental in the passage of the tabling motion. It is important that IEEE members understand the background of this episode so that they can better appraise the BOD's past actions and consider trying to influence future action in this area.

BACKGROUND

The proposals presented in San Diego by Walter Elden were the culmination of an evolutionary process within the IEEE that can be traced back over a period exceeding 4 years. (This is not to say that a more thorough study would not reveal still earlier antecedents.) In October 1973 the Employment Practices Committee (EPC) of the U.S. Activities Committee (previous name of USAB) began formal consideration of a proposal put forward by CSIT to support the ethical engineer by establishing mechanisms along the general lines of the current proposal. Some months earlier, EPC had initiated studies of codes of ethics, also receiving a major input form CSIT. On the latter point, the result was a code that USAC approved and passed on to BOD, which adopted it for the Institute in modified form on December 4, 1974.

A third effort in the ethics area also originated at about the same time. CSIT investigated the BART case and, in a March 1974 resolution, recommended to BOD that the Institute formally intervene in support of the 3 engineers and also set up general machinery to deal with such cases. EPC carried out another investigation that confirmed the

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recommendations to the Board culminated in the amicus curiae brief that the IEEE filed in the BART case January 9, 1975.

Meanwhile the EPC (later re-designated the Ethics and Employment Practices Committee—EEPC) drafted and discussed a number of versions of proposals to support and enforce the code of ethics. IEEE attorneys were consulted, and information and advice was obtained from the staff of the American Association of University Professors (AAUP), an organization that has been for many decades successfully carrying out the kind of operations contemplated. A factor which impeded the upward progress thru the IEEE hierarchy of proposals in the ethics area was the frequency with which membership—and the chairmanship—of EEPC changed. There was a continual need to repeat the initial stages of the discussions for the benefit of new members.

This discontinuity problem reached a new level in September 1975, when Arthur Rossoff resigned as EEPC chairman because he felt that the positions developed by the committee were not receiving an adequate hearing before BOD. Subsequently EEPC was dissolved, and in 1976 several USAB task forces were formed to develop procedures to support and enforce the ethics code and to consider revisions to the code. Only the enforcement group produced a report, submitted in May 1976. The recommended procedures were prefaced by an explicit statement that enforcement procedures should not be put into effect before procedures to support ethical engineers were in place.

7.9 A. Infractions of the Institute's Code of Ethics by members, when reported to and investigated and evaluated by the Board of Directors, or its designated representative, are subject to appropriate action by the Institute's Board of Directors, on the basis of procedures established by that body.

7.9 B. Members who are placed in jeopardy as a consequence of adherence to the Institute's Code of Ethics may be offered assistance, provided that, in the opinion of the Board of Directors, or its designated representative, such assistance is warranted.

In 1977, USAB set up the present Ethical Conduct Task Force, charged with developing procedures for implementing the above resolutions and considering possible revisions of the ethics code. The members are Walter Elden, Stephen Kowel (Chairman), Faith Lee, John Thatcher (a BOD member), Stephen Unger, and Victor Zourides.

Meanwhile, without notification of individuals or other entities involved in these matters, BOD in December 1976 added to the Bylaws of the IEEE a provision (numbered 112) authorizing BOD to

> "expel, supsend or censure a member for cause. Cause shall mean conduct which the Board of Directors determines (1) to constitute materially unlawful conduct, a material violation of the code of ethics of IEEE, or other materially unprofessional conduct; and (2) to be seriously prejudicial to the best interests of IEEE." [emphasis added].

NEW SUBSCRIPTIONS: Please see "Notice to Readers" on page 20.

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ing with such situations based on an investigation and preliminary determination by a standing 3-person committee appointed by BOD, followed by a hearing before BOD, which makes the final decision. Bylaw 112 does not provide for IEEE support of members who are placed in jeopardy as a consequence of adherence to the IEEE code of ethics.

The USAB Ethical Conduct Task Force proceeded to develop its proposals for both support and enforcement of the code (the enforcement part intended as a replacement for Bylaw 112). These proposals were approved by USAB and forwarded to BOD for its consideration at the July 1977 meeting.

At that meeting, the Board decided that more discussion was necessary on an Institute-wide basis, and that the proposals should be put in legal form appropriate for direct inclusion in the Bylaws. The Task Force was asked to refine its proposals and bring them back for consideration in November 1977. The BOD also asked each of the other Institute Boards to review the matter. Simultaneously, the Board appointed the 3-member committee (headed by James Fairman) referred to in Bylaw 112, and instructed it to prepare detailed rules of procedure.

Between July and November the USAB Task Force proposals were carefully refined, with assistance from legal consultant Frank Cummings and IEEE counsel James Wiener. The chairman and USAB Staff members (principally Leo Fanning) also consulted extensively with the staffs of a number of organizations with relevant activities, interests, and experience. These included AAAS, NSF, ASCE, ACS, AAUP, ASP, Consumers Union, and the American Society of Association Executives. The procedures were carefully framed so as to minimize the possibility of libel suits, to ensure that BOD would have the final word prior to any critical action, and to make it clear that the IEEE was in no way engaging in collective bargaining. Efforts were made by Task Force members to contact BOD members and try to resolve any questions that they might have. Advance indications were that the great majority of BOD members were favorably inclined toward the proposals. However, as noted above, confusion as to how to intermesh the Task Force proposals and the Fairman proposal led to the tabling motion at the November meeting.

The IEEE is in a position to take a major step toward improving the status of the engineering profession. Adoption of the ethics support proposal of the Task Force would mean that an individual trying to practice engineering in accordance with the ethical standards of his profession would have the support of the world's largest engineering society. This support would inevitably have a significant deterrent effect on any unscrupulous managers who at present might try to further their own careers and cover their own ineptness by pressuring their subordinates into unjustifiable corner-cutting. Competent, ethical managers would benefit by their technical staff's more professional behavior.

Concerning enforcement of the ethics code on IEEE members, the Task Force proposal was thought out very carefully to ensure due process and fair play. That is not to say that improvements cannot be made, and perhaps elements of the Fairman proposal, also the product of able, highly-motivated people, could be incorporated.

One basic element of Bylaw 112 is, however, unsupportable. As indicated in the portion quoted above, the BOD can punish IEEE members for "other materially unprofessional conduct." This is a serious violation of due process, since it leaves one to guess as to what the present or some future BOD might consider as fitting this term. It is unfortunate that a board that is proceeding so cautiously in considering measures to support IEEE members who act ethically, should be so hasty as to adopt a measure that could conceivably lead to an IEEE member being condemned on the basis of such an open-ended provision.

As we go to press, we have learned that, at its February meeting, the BOD will consider a detailed proposal by Mr. Fairman to amend Bylaw 112 so as to incorporate ethics support procedures. The proposal has been endorsed by the BOD Executive Committee. Adoption of meaningful ethics support procedures would represent an important advance in engineering professionalism.

REFERENCES

1. Draft Report of Ethics Task Force: T&S, 9/77, pp. 8-12.
2. Early CSIT proposals on ethics code and support: T&S (formerly CSIT Newsletter), 12/73.
3. IEEE Ethics Code: Spectrum, 2/75, p. 65.
4. Outline of last EEPC Proposal: T&S, 3/76, p. 27.
5. BART Case: T&S, 9/73, p. 6; 6/74, p.3; 12/75, p.1.

SOLAR ENERGY: A STATUS REPORT

"Solar Energy: A Status Report", was one of the best-attended sessions of the entire ELECTRO 77 Convention. The size of the audience, estimated to be approximately 200, illustrates the level of general interest in solar energy. The session was organized and chaired by Dr. David Redfield of RCA Laboratories, who is also the chairman of CSIT's Working Group on Energy/Environment. The session was well planned, and the speakers represented different sectors of the engineering field, all vitally interested in solar energy.

H.H. Marvin, Director of the Solar Energy Division of the Energy Research and Development Administration (ERDA), described his agency's role in stimulating solar technology. ERDA was formed three years ago to coordinate Federal efforts in energy research, development, and demonstration. In his paper, Dr. Marvin states that ERDA's short-term priorities are directed toward conservation technologies and the exploitation of currently-available energy sources, in order to stretch present fossil fuel supplies. Long-term strategies are directed toward development of fusion, breeder reactors, and solar electric technology. Primarily, ERDA catalyzes the growth of solar technology by awarding contracts to the private sector, thereby creating new or greater markets or, as in the case of photovoltaic cells, to induce cost reductions by making massive competitive buys. In the area of hot water heating, no technological stimulation is necessary. Here, the Federal role is to induce the development of industry standards, to educate heating contractors and maintenance persons, and to influence loan requirements, codes, and utility rate structures in such a way as to encourage solar installation. After stimulating a particular solar market, the Federal aim is to "disappear from the scene, leaving a healthy industry." ERDA's budget has been increasing yearly: $46 million in FY 1975, $115 million in FY 1976, and $290.4 million in FY 1977 (for all solar technologies, including wind, biomass, etc.). He said that possible adverse environmental impacts of solar technologies should be borne in mind, but he believed them to be so minor that "solar energy has an image akin to motherhood." Environmental impact studies of solar technologies are being conducted.

Albert Weinstein, of Westinghouse Electric Corp., described two solar (space and water) heating and cooling projects undertaken by his company. The first project, sponsored by ERDA, was a large-scale heating and (absorption) cooling system for an elementary school in Atlanta, Georgia. The solar collector area is 10,000 square feet. Water is used as the storage medium, and a gas-fired boiler provides back-up capacity. In contrast, a Lake Montclair, Virginia residential system is a solar-assisted heat pump system utilizing air instead of water as the heat transfer fluid, rocks instead of water for heat storage, and a heat pump instead of a boiler as the auxiliary (conventional) heating subsystem. The heat pump also provides the summertime cooling (non-solar). Each residence has 11 solar air collectors constituting 220 square feet on the south-facing roof, tilted at an angle of 60° to the horizontal.

John Goldsmith, of the California Institute of Technology's Jet Propulsion Laboratory, described some of the methodologies for growing silicon sheets for solar cells. He discussed the Low-Cost Silicon Solar Array (LSSA) project, a part of the ERDA solar photovoltaic development program. Under LSSA, a diversity of approaches are being investigated simultaneously; the more promising techniques would then be supported for further development. Among the different processes being studied are advanced ingot growth techniques, edge-defined film-fed growth ribbons, and dip-coated techniques. Before the ribbons or wafers can be grown and cut, the silicon must be refined to semiconductor grade, which is currently purified to less than one part per billion. According to Dr. Goldsmith, of the 500 kW-h required to produce one kilogram of silicon, 450 kW-h are consumed in the reduction of a highly-purified chlorinated silicon ($SiHCl_3$) to semiconductor grade silicon.

Piet Bos, of the Electric Power Research Institute (EPRI), discussed the effects of solar energy on the electric utility industry, and his paper lists some of the practical problems currently associated with the various areas of solar energy. (Interestingly, his talk was not as pessimistic as his paper.) At the utility end of the transmission lines, the highly-correlated outages of nearby solar power plants tied into an electric grid, due to cloud cover, require that these plants be backed up by conventional power systems to maintain reliability. Successive cloudy days will also cause customers to switch from solar heating & cooling to backup systems (probably electric); thus, solar systems generally cause adverse load factors, *a cause for concern among the electric utility companies. Mr. Weinstein had also discussed this topic, and had suggested relying on the marketplace to increase load factors—by adopting time-of-day, peak-load, or seasonal pricing.

Among them, the four speakers covered most of the topics of current interest in solar energy. Highlights of their presentations follow, on a topic-by-topic basis.

DOMESTIC HOT WATER HEATERS

This application is not new; over 50,000 solar hot water systems were sold in Florida, California, and similar areas between 1935 and 1950—before low-cost electricity and natural gas became available. With rising fuel costs, solar water heaters are again becoming economically attractive. Complete "packaged" systems are currently available at an installed cost of $850 to $1,500.

As gas and oil supplies dwindle, electricity will probably be the dominant form of energy supplied to homes. Dr.

*load factor = average load/peak load.

tion, which concluded that, in many parts of the country, solar space heating and hot water heating are now competitive with electrical resistance heating. This study used a figure of $20 per square foot installed price for solar energy and the need for 50 to 100 square feet of collector.

SOLAR HEATING AND COOLING OF BUILDINGS

Dr. Marvin noted that about 25 percent of the U.S. energy useage is for the heating and cooling of buildings. (Of that 25 percent, about one-fifth is for the production of domestic hot water.) He stated that the Federal government, in its effort to help establish a viable solar industry, has contracted for the construction of more than 1600 solar housing units since 1975. Awards for solar heating of many non-residential buildings have also been negotiated.

Mr. Weinstein provided some data and projections concerning solar space heating and cooling: On a life-cycle cost basis, solar home heating and cooling systems are becoming competitive in many parts of the country. However, the initial investment for a solar system is several thousand dollars greater than for a conventional system. For most solar installations, life-cycle costs are minimized if the system includes an auxiliary (conventional) energy source to augment the solar system during periods of cloudy weather or extreme temperatures; a solar dependency of between 50% and 80% of annual heating/cooling requirements represents the boundaries between a lower limit of saving fuel and an upper limit of acceptable capital costs. To be economically and aesthetically attractive, the house should be specifically designed for a solar system. Retrofitting single-family residences is not likely to be economical on a significant scale, but retrofitting larger buildings, such as public buildings, with solar systems is approaching economic feasibility on a life-cycle cost basis.

In an attempt to avoid the adverse load factor of direct solar heating and cooling systems, Mr. Bos said that EPRI is investigating solar-assisted heat pumps and their use in SHAC (solar heating and cooling) systems. Solar-assisted heat pumps are twice as efficient as conventional heat pumps and three times as efficient as electric resistance heating.

None of the speakers discussed the most economical technique for meeting at least a part of space heating needs, passive solar heating, in which innovative design of homes and other buildings uses available solar radiation to maximum advantage.

PHOTOVOLTAIC ENERGY CONVERSION

Photovoltaic cells convert radiant solar energy directly to electrical energy. They have been successfully used to provide energy for spacecraft and for some remote terrestial applications such as floating buoys and telephone equipment. At this time, however, photovoltaic devices are not cost-competitive with conventional electric power generation. Dr. Marvin writes:

> "...The economies are out of sight. Having said that, let me say that there is some good news and some bad news. The bad news is that the price per peak kilowatt is now about $15,000. [illegible] $100,000. As the cost comes down, markets appear, for example, remote signals for railroads, weather stations, emergency phones on highways, and so on. That is, there exists a price-volume curve as for any new product. The Federal role is to induce cost reduction by making massive competitive buys. Our target in this buying program is purchases over the next decade, at a constant level each year, with volumes of silicon arrays increasing while prices come down to an objective of $2,000 per [peak] kilowatt in 1981 and $500 per [peak] kilowatt in 1986. Five hundred dollars per kilowatt is the order of the capital cost of building a coal plant today. We believe there is a 50/50 chance that this goal can be accomplished. The ultimate objective must be of the order of $100 to $300 per kilowatt and the chances of achieving that cannot yet be estimated."

Mr. Goldsmith is optimistic that photovoltaic devices will ultimately be cost competitive with conventional electrical energy sources. Citing recent results of the LSSA program, he ends his paper on this note:

> "Recently reported assessment of cost to convert silicon sheets to solar arrays conducted by RCA, TI and Motorola has indicated that with reasonably straightforward extrapolation of semiconductor industry technology to the problem, cost within a factor of two or three from the required cost for these process steps can be anticipated. Furthermore, this data suggest that the realization of this further reduction, down to the desired cost can be accomplished with innovation. Invention of basic new technologies are probably not necessary to bring this part of production cost within acceptable bounds.
>
> The potential to reach a selling price of $0.50/Watt(peak) solar photovoltaic array power source by 1986 is encouraging. There is still a long way to go, however, before it can be stated unequivocally that the technical cost problems have been resolved. 1977 will be an important year. With continued good progress and the excellent support of industry and ERDA, the time may not be far in the future before practical large scale application may become a reality."

Mr. Bos is less optimistic. The following quotations are from his paper:

> ". . .The $500/peak kW number is very misleading, since it represents the cost per unit output at solar noon and not per unit of rated output which is the common designation in costing of conventional power plants.
>
> Since a kilowatt output at solar noon is four to five times the average or 24-hour kilowatt output, the rate cost of the array alone is four or five times the $500/peak kW and two to three times for intermediate load applications. On the basis of competitive fuel prices from other sources there appears to be a limited market for systems using arrays at this cost. These cost figures do not include other power plant costs such as supporting structure, anchoring, land, inter-array wiring, power conditioning, storage, AC/DC conversion, switchgear, facilities, indirect costs, (A&E fees, spare parts & contingencies) and interest during construction.

sion efficiencies drop far below 10 percent, thereby requiring larger arrays for a given output, the supporting structure, anchoring, land, and wiring costs alone would be much higher than conventional total plant costs, even if the solar cells were given away for free."

It should be noted that many of the cost elements cited by Mr. Bos would be reduced or eliminated in total energy residential systems, in which the photovoltaic cells would be incorporated into the solar collectors used for space heating.

WIND ENERGY

ERDA personnel have reached the conclusion that wind machines appear to be most economical in two ranges. Small windmills, of the order of 10-30 kilowatts, might supply electrical energy to a dozen houses or to a large farmstead. Large windmills, of the order of 1.5 megawatts, could be of interest to electric utilities. A 100-kilowatt machine has already been constructed, and another one is being built. Two 1.5-megawatt wind machines will be built, starting in 1978. All four windmills require high average wind velocities (i.e., about 18 mph) to achieve rated output. ERDA's goal is to develop a 14-mph wind machine at a cost of $750 per kilowatt.

SOLAR THERMAL ELECTRIC POWER

In solar thermal conversion, sunlight concentrated by mirrors heats a boiler to produce high-pressure steam to drive a turbine to generate electricity. Mr. Bos said that the heliostat/central-receiver concept is likely to produce electricity at lower cost than is the distributed system (which uses parabolic trough reflectors) because:

1. The higher receiver temperature allows more efficient solar-to-electric energy conversion, hence requires less reflector area per kilowatt of output. This, despite the costly selective coatings and vacuum envelopes often employed in the distributed collectors.
2. Optical transmission of energy to the central receiver avoids the cost of the insulated transmission pipes required in the distributed system.

A 35-kilowatt solar thermal plant has been tested at Sandia Laboratories in Alburquerque, and performance exceeded design specifications by 30 percent. The goal is to reduce the cost of solar thermal energy conversion to $1300 per kilowatt by 1987 (for a 100-megawatt power plant). ERDA is also developing systems in the 25 to 400 kilowatt range for irrigation systems and the 400 kilowatt to 10 megawatt range for small communities and large buildings. Cogeneration, using the waste heat to heat buildings, is an integral part of the program.

OCEAN THERMAL ELECTRIC POWER

As in solar thermal conversion, a fluid is boiled, and the vapor is used to drive a turbine generator. Here, use is made of the temperature difference between deep ocean waters and the warmer surface water. A working fluid with a low boiling point (e.g., ammonia, propane) is used. Since the temperature differential is so small (45°F at the maximum), the conversion efficiency will be very low, and the heat exchangers must be very large. Nevertheless, the approach might ultimately be economically feasible.

Another advantage of ocean thermal energy is its availability day and night, cloudy day or sunny day. Ocean thermal conversion raises many environmental questions, including the possible release to the atmosphere of dissolved CO_2 at a rate comparable to that from fossil fuel combustion.

BIOMASS

In the US, photosynthesis stores energy in plant matter at a rate that is comparable to total US energy consumption. This "biomass" represents an especially convenient renewable energy resource, since relatively simple technologies can convert it to gaseous fuels to supply existing pipelines, or to liquid fuels to power aircraft and automobiles. Agricultural, municipal, and forest wastes could supply 7% of current US energy needs, and biomass "farms" located on non-productive land (such as periodically-waterlogged land) could greatly extend this total without intruding into wilderness areas or wildlife habitats. Agricultural wastes and other non-woody biomass are best suited for conversion to high-quality fuels like alcohol, methane, and hydrogen; municipal and forest wastes can be used to fire boilers, either in direct combustion or after conversion to char. A wide variety of biological, chemical, and thermal conversion processes—producing a wide variety of fuels and other end products—are technically feasible.

Biomass is likely to be competitive with coal, both as an industrial boiler fuel and as a feedstock for the production of synthetic liquid and gaseous fuels. Moreover, biomass is a renewable energy resource, and its combustion leads to no net buildup in atmospheric CO_2. This technology is still in its infancy and probably offers the highest expected return on R&D dollars of any energy technology.

None of the speakers placed much emphasis on biomass. Dr. Marvin said that ERDA's biomass program was started relatively late and that thus far none of the technologies had progressed beyond the experimental stage. Mr. Bos asserted that the currently-projected costs of fuels derived from biomass were much higher than for alternative methods of fuel production.

Aaron Ashkinazy

PROGRAMS FOR ENERGY CONSERVATION

Dedicated primarily to energy conservation, this session featured four speakers and a panel discussion. Since this topic will become progressively more important to the public within the next few years, it is unfortunate that the session was not well attended.

According to Melvin R. Meyerson, Chief of the Products Systems Analysis Division of the National Bureau of Standards, a 1968 study conducted by the Stanford Research Institute revealed that energy consumption in the U.S. was distributed as follows: Residential – 19.2%; Commer-

tion – 25.2%. The total energy consumed in 1968 was 60.6 Quads (1 Quad = 10^{15} Btu). In 1972, total energy consumption was 71.6 Quads, and anticipated energy consumption for 1980 is 100.3 Quads. The talks in this session were addressed to residential and commercial energy consumption, which is approximately 1/3 of the total U.S. consumption.

The first talk, presented by Dr. Howard D. Philipp of Niagra Mohawk Power Corporation, was only marginally relevant to energy conservation. Improved utility load management – the topic of his talk – could produce a small saving in fuel, but this potential benefit was peripheral to his presentation.

The second speaker was Charles Guinn, who heads the Policy Analysis and Planning Unit of the New York State Energy Office. He expressed the view that energy conservation was more a function of the collective will of the people than a technological feat. Savings of 30% on energy consumption could be achieved, but Mr. Guinn felt that there are currently few economic incentives for conservation.

Mr. Guinn's department advises the governor on energy matters. The goal is to reduce statewide energy consumption by 5% by 1980. Some of the methods being contemplated to achieve this reduction are:

(a) Increase lighting efficiency, and enforce lighting – level standards in rooms available to the public.
(b) Promote car pools and mass transportation.
(c) Require thermally – efficient building codes (e.g., insulate foundations, retrofit existing homes, require therma efficiency data upon home resale). Mr. Guinn also favored utility help in financing home insulation.
(d) Regulate siting of power plants, encourage use of solid waste for fuel, and make utility facilities more energy efficient.

Melvin Meyerson was the third speaker. He discussed the Energy Policy and Conservation Act, P.L. 94 – 163, which became law in December 1975. Although this Act covers many areas (domestic energy supply availability, standby energy authorities, petroleum pricing policy, and automotive fuel economy), Mr. Meyerson concentrated on one section (Title V, Part B) that describes an energy conservation program for consumer products other than automobiles. This provision of the Act covers 13 product areas, mostly household appliances (e.g., refrigerators, freezers, dryers, television sets, air conditioners, etc.), and therefore has been called the Appliance Labeling and Efficiency Provision. These provisions fall into two categories: (a) products will be labeled to indicate to consumers the estimated annual costs of operation, along with similar data for competing products; and (b) using the year 1972 as a base, energy efficiency targets will be established such that, by 1980, overall weighted production improvements for most of the 13 product categories covered will exceed 20%.

Three federal agencies have the responsibility of implementing the law. The Federal Energy Administration and performing any function not specifically assigned elsewhere. The Federal Trade Commission (FTC) is responsible for carrying out the labeling provisions. The National Bureau of Standards (NBS) is assigned two functions: (a) develop test procedures to obtain estimates of annual product operating costs; and (b) set product efficiency targets for 1980.

All manufacturers must comply with the labeling provisions of the law. However, there are no direct penalties prescribed if manufacturers fail to meet the efficiency targets. If it becomes clear that a target for a particular product will not be achieved, the Administrator of FEA is required to set an energy efficiency standard. Unlike the target, which is a production – weighted average value that could include low efficiency items, the standard prohibits sale of any item in the product category that falls below the energy efficiency minimum.

Ephraim Weiss, of the New York State Assembly Scientific Staff (also the Session organizer and chairman), described his job as "getting technology to the lawmakers." His own agency, the Federal Energy Research and Development Administration (ERDA), the Atmospheric Sciences Research Center (ASRC) of the State University of New York, and Sambo's (a restaurant chain) are involved in a joint project to obtain return – on – investment data for energy conservation equipment in a fast – foods restaurant. This data will be used to provide any interested business firm "with practical working knowledge of how it can benefit from employing energy conservation techniques and equipment."

Since there was no precedent for this type of cooperative venture, some institutional problems had to surmounted: "Under an ERDA contract with Sambo's, the Jolly Tiger restaurant was built in Colonie, N.Y. with Elsters as the supplier. Sambo's had overall responsibility, and ERDA agreed to pay for the incremental portion of the cost which related to the project, above and beyond that associated with a normal restaurant. The construction was performed in co-ordination with the New York State Assembly Scientific Staff and ASRC, who were responsible for the instrumentation and data collection and analyses."

Superficially resembling any other fast-food restaurant, this site is actually a highly-instrumented working laboratory containing many built-in sensors to monitor and record energy and temperature data on the building. Numerous conservation measures were built into the restaurant:

(a) Insulation: Double-glass windows, reduced in size; full wall insulation and extensive insulation under the slab near the periphery.
(b) Clock-controlled exhaust fan, manual controls of interior and exterior lighting levels, automatic on/off control of lights near windows, timed shutdown of dishwasher exhaust fan.
(c) Heat reclamation system from the kitchen exhaust hood, air conditioners, refrigerator rack, and dishwasher. (It is estimated that this reclaimed heat could provide for at least half the hot water heat requirements of the restaurant.)

began in November 1976. At the time of this session, no significant conclusions could be drawn based on the limited data then available.

In the ensuing panel discussion, William S. Fleming, of William S. Fleming Associates, had some interesting statements concerning solar energy. He said that a restaurant chain found that utilization of solar energy paid off in Phoenix, but not in Boston, at current conventional mounting fuel costs. He mentioned that there is an increasing demand for solar water heating in California, because it is now illegal to heat swimming pools there using non – renewable energy sources. Mr. Fleming also said that Syracuse uses solid waste to generate electricity and Rochester has implemented a solar – assisted heat pump system.

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PRIVACY, CRYPTOGRAPHY AND FREE RESEARCH

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THE SALIENT EVENTS

Early in July 1977, Mr. E.K. Gannett, IEEE Staff Director of Publishing Services, received a letter (with enclosures) from IEEE member J.A. Meyer of Bethesda, Maryland. The letter warned that some of those presenting papers at the forthcoming International Symposium on Information Theory sponsored by the IEEE Professional Group on Information Theory and possibly the Institute itself might be subject to prosecution by the Federal Government for violation of the Arms Export Control Act.

The papers at issue dealt with data encryption techniques, all resulting from unclassified research carried out at institutions such as MIT and Stanford University. Important parts of the work concerned had already been described in *Science* (AAAS Periodical) and in the *Scientific American.* Subsequent inquiries by *Science* and *The New York Times* indicated that Mr. Meyer is an employee of the National Security Agency (NSA), a large, top – secret federal agency dealing with communications aspects of espionage and military intelligence. This affiliation was not mentioned in the letter, and an NSA spokesman, while stating that NSA "had nothing to do with the letter", would not comment on whether he had seen the letter or on whether Meyer did work for NSA. *The New York Times* also reported that other thinly – veiled threats have been made against researchers in this area by NSA employees, and that the National Science Foundation has been the subject of pressure designed to bring cryptography research under NSA control.

Neil D. Pundit, IEEE Director of Technical Activities, was asked by Mr. Gannett to use his judgement in advising the conference organizers about the implications of Meyer's letter. His response was a memorandum to those involved which conveyed his opinion that, while the IEEE and its officials were exempt from the regulations, individual authors and their employers were not. He advised authors working for defense contractors to get their papers cleared through their employers prior to publication, and he advised all other authors to seek prior publication approval from the Office of Munitions Control, Department of State. (*Science* reports that officials at the Office of Munitions Control informed them that such requests involving cryptography would be referred to NSA. Hence, the effect of such a procedure would be to give NSA the power to censor all publications in this field.)

This advice was not taken by Information Theory Group officers or the authors concerned. After consulting with the attorneys of several universities, it was decided to proceed without seeking government clearance. The discussions of some papers at the meeting (held at Cornell University in October 1977) were kept clear of certain areas, and certain papers whose principal authors were students were presented by a faculty co – author (Professor Martin Hellman of Stanford University) who was assured that university lawyers would defend him if a prosecution resulted, but might not defend the students.

Dr. Fred Jelinek, president of the Information Theory Group, requested on behalf of the group: 1) that the IEEE Technical Activities Board recognize cryptography as a proper field of interest of the Information Theory Group; and 2) that TAB ask IEEE lawyers to conduct a legal study into the ramifications of the regulations at issue. At its November meeting in San Diego, TAB deferred action on the first proposal (to enable individual groups/societies to review the proposal) and rejected the second proposal.

WHY CRYPTOGRAPHY?

Since cryptography traditionally has been a subject of interest primarily to puzzle enthusiasts and military intelligence agencies, the reader might reasonably ask why there should be any resistance to the idea of leaving it to NSA. (Some broader issues will be mentioned later.) The answer lies in the growing use of computers to store and process a wide variety of data that impact the everyday lives of almost everyone. If the trend toward the digital encoding of even voice telephone communications is included in the class of computer – readable data, then a truly vast amount of information falls into this category. Financial operations, already on a significant scale and due for a further rise with the advent of electronic funds transfer systems, consititute an important part of the picture.

With so much data circulating in digital form, problems of privacy and security have inevitably arisen. A major argument against the growing use of computers is the ease with which large quantities of data concerning many people can be misused. The danger of computer fraud has

operations.

Part of the problem is institutional in nature, such as the collating of computerized information from many sources to construct elaborate dossiers on individual citizens; or the selling of computer tapes of mailing lists to add to the flood of junk mail inundating us; or the threat of automatically – dialled junk telephone calls using as sources computer – generated lists of telephone numbers. The solutions to these problems must be found largely in the social and legal domain, probably thru the passage and enforcement of carefully – devised laws and regulations.

However, another part of the problem, that of unauthorized interception – – or even transformation – – of data, has a technical solution, namely *encryption.* Rudimentary cryptographic techniques have been used for many years in the computer field to protect very high priority data and even more widely to restrict access to on – line systems thru the use of passwords. However, the state of the art is not adequate to support the large – scale applications currently envisaged. Encrypted messages must not be appreciably longer than the plaintext, to avoid inflating memory and transmission costs. The encryption and decryption processes must be well adapted to modern digital circuitry. Keys must not be any longer than is necessary to defeat attacks by exhaustive enumeration. Finally, it is important that schemes be found that can be shown to be secure against highly sophisticated and powerful codebreaking techniques that exploit the power of modern computers and have available as clues extensive files of messages in both coded and cleartext forms. Other special problems include the devising of systems for transmitting private messages between arbitrary pairs of individuals in a large network without proliferating the number of keys required.

Classic cryptographic techniques have not been able to meet the challenge outlined above. As its importance has become more evident, engineers and computer scientists have been giving increasing attention to the field of cryptography, and important new ideas have resulted. A number of these were presented at the Information Theory Symposium cited in the previous section, where important connections were established between cryptography and the theory of computational complexity. These may point the way toward the development of practical encryption techniques that can be rigorously shown to be essentially impervious to code – breaking efforts. This goal has not yet been achieved, but work by Diffie, Hellman, Rivest, Shamir, Adleman and others has already led to useful techniques.

It is important to understand that all of the research under discussion concerns the development of secure privacy systems. It has no application to techniques for codebreaking.

While NSA has an important task in ensuring the security of information transmission by U.S. government agencies (principally – – but by no means only – – the military), it also serves as that government's principal

Altho its activities are heavily veiled, it is widely believed that, in addition to intercepting communications by governments considered as unfriendly to the U.S.A., NSA has done the same to neutral and even allied nations. But NSA has not stopped there. A few years ago Senate hearings revealed that the NSA had routinely monitored telegraph communications between American citizens on a massive scale and that this surveillance involved people who were under no suspicion of wrong – doing. In fact, altho these activities were severely attacked at these hearings, no examples of how they had produced results in the national interest were brought forward by NSA to justify this illegal behavior.

The NSA is only one of a number of agencies of federal, state, and local governments that have been engaged in snooping activities directed against a wide variety of American citizens over a period exceeding 3 decades. For example, the FBI, CIA, and Army Intelligence have all been actively involved. These assaults on privacy have taken the form of wiretapping, bugging, opening of mail, burglary, etc. It is for this reason that the behavior of the NSA in the current controversy must be viewed with considerable suspicion.

Just prior to the events outlined in the previous section, a closely – related episode occurred in connection with the development of an integrated circuit chip for use in encrypting and decrypting data between terminals and computers. The equipment involved, designated as the Data Encryption Standard (DES), was developed by the National Bureau of Standards in cooperation with IBM, who is marketing it. This apparatus is intended for very widespread commercial use in this country and abroad.

Serious questions were raised by a number of non – governmental experts as to the vulnerability of the technique to codebreaking by computerized enumeration or by special analytic methods. The involvement of several former NSA employees in the development process and the fact that NSA itself participated informally, combined with the suppression of information necessary to evaluate the technique, fostered a suspicion that the NSA might be surreptitiously promoting a system that would facilitate its codebreaking operations. One aspect of the argument concerned the key length for the DES chips. The 56 – bit length chosen for DES does not preclude an exhaustive enumeration attack by a large, special – purpose computer that NSA could build, tho at a large cost. A key size exceding 100 bits would eliminate this possibility and would not increase the cost by very much. There are indications that NSA blocked the use of a larger key size. On the other hand, it has been pointed out that security against this sort of attack can be achieved with the DES chips by doubly encrypting messages with 2 different keys, thereby achieving an effective key size of 112 bits. Of course, this expedient still does not deal with the possibility of a more fundamental built – in vulnerability to codebreaking.

THE ISSUES

The cryptography – NSA controversy raises a series of issues of importance to IEEE members, both professional-

starting points for further discussions.

(1) A line of research that is helping to combat threats to privacy may be choked off.

(2) Altho the term "national security" has been and will be invoked by those trying to suppress this research, a more likely result if it is suppressed in the U.S.A. would be that this country would fall behind others in this field.

(3) A dangerous precedent would be established if a secret agency, acting surreptitiously, were permitted to determine unilaterally that a particular line of research should be suppressed in order to further its own objectives.

(4) According to Mr. Meyer, it is necessary to obtain prior approval by a cognizant government agency before any *un*classified technical information covered by International Traffic in Arms Regulations (ITAR) can be published *within* the U.S. Part 125.01 of these regulations includes in the definition of technical data covered by ITAR:

> "any unclassified information that can be used, or be adapted for use, in the design, production, manufacture, repair, overhaul, processing, development, operation, maintenance, or reconstruction of arms, ammunition, and implements of war on the U.S. Munitions List [A very comprehensive list including all sorts of electronic equipment]; or any technology which advances the state-of-the-art or establishes a new art in an area of significant military applicability in the United States."

It would be hard to think of any papers published by IEEE members that are not encompassed by this definition. Further, these regulations (footnote to 125.11) place the burden of obtaining publication clearance for such material on the author. Obviously these regulations have not been enforced in this manner. But they hang over the heads of engineers and scientists, making nearly all who publish papers subject to the specter of criminal penalties if certain government officials choose to prosecute. It may therefore become very dangerous to incur the wrath of such officials for any reason at all.

(5) Apart from the threat to open research and to individual researchers, the existence of such regulations calling for prior censorship would seem to be in clear violation of first amendment rights to free speech and freedom of the press.

THE ROLE OF IEEE

As the largest engineering society and as one that has already been directly impacted by this issue, it seems reasonable to expect the IEEE to take a strong public position on the principles, to indicate its willingness to defend any member who might be singled out for prosecution, and to press for changes in the laws and regulations. A preliminary step should be a careful study of the relevant regulations and laws by its attorneys. A committee headed by Dr. David Slepian has already been charged by the Governing Board of the Information Theory Group to study the matter. This committee, possibly augmented by representatives of other IEEE entities, might be given Institute-wide status to recommend detailed procedures.

Acknowledgement: The author wishes to thank Dr. N.D. Pundit for making available to him a number of key documents on this issue.

1. Science, 7/29/77 pp. 438-440; 8/19/77 pp. 747-748; 9/30/77 pp. 1345-1349; 10/7/77 p. 8; 11/4/77 p. 476.
2. Scientific American, August 1977, pp. 120-124.
3. N.Y. Times, 10/19/77 p. A26.
4. ITAR Regulations, Federal Register 7/22/72.
5. Letter: Meyer to Gannett, 7/7/77.
6. Letter: Gannett to Meyer, 7/20/77.
7. Memorandum: Gannett to N.P. Dwivedi (former name of N.D. Pundit), 7/20/77.
8. Memorandum: Dwivedi to members of Information Theory Group, 8/8/77.

[Ed. note: Dr. Slepian has requested that IEEE president Ivan Getting engage IEEE legal counsel to look into the matter of ITAR, particularly the issues raised by the cryptography affair described above. This request was approved by Dr. Getting, and IEEE legal counsel is actively working on the matter.]

CRIME DETERRENT TRANSPONDER SYSTEM

[A paper with the above title, authored by J.A. Meyer, 4823 Willet Parkway, Chevy Chase, MD 20015 appeared in the *IEEE Transactions on Aerospace and Electronic Systems,* Vol. AES-7, No. 1, January 1971, pp. 2-22. Reprinted below are the abstract of this paper, the first two paragraphs of the paper, and the accompanying biography of Mr. Meyer. These items appeared in the December 1977 issue of the *IEEE Information Theory Group Newsletter.*]

Abstract: A review of some of the underlying reasons for crime is presented, together with a perspective-setting view of the present status of crime in the United States. A statistical analysis of the number of repeaters is presented as the basis for a crime control system consisting of a transponder carried by each convicted person after he is released from confinement. Real-time tracking of these transponders is done by a computer-radio system; when a crime is committed a quick check shows at least who was not involved. Countermeasures and some social implications are also covered.

Probability and information play an important part in crime, law enforcement, and the deterrence of crime, but frequently the effects are negative. Modern electronic technology can be employed to generate information and to change crucial probabilities—particularly the probability of identifying a suspect—and thus affect the whole process of crime by changing the risks. In a proposed scheme, small radio transponders would be attached to criminal recidivists, parolees, and bailees to identify them and detect their whereabouts. These transponder data, processed in real time, then provide timely information to enable police to apprehend a named suspect very soon after a crime.

There are a number of complications, because the subscribers, i.e., the persons with transponders, can use countermeasures to combat the surveillance system; but the net effect of the transponder system is that the pro-

certainty by this technology. As a consequence, the system of confining criminals in prisons and jails, to punish them or prevent them from committing further crimes, can be replaced by an electronic surveillance and command-control system to make crime pointless.

20, 1929. He received the B.S. degree in mathematics from Rutgers University, New Brunswick, NJ, in 1952. After serving in the Air Force from 1952 to 1954, he joined the Department of Defense. He has worked primarily in the fields of mathematics, computers and communications in the United States and overseas.

NEWS, NOTES, AND COMMENT

RESEARCH PROJECT ON BART ENGINEERS

An interdisciplinary team of researchers from Purdue University is doing an in-depth case history of the events surrounding the dismissal in 1972 of three engineers from the San Francisco Bay Area Rapid Transit District (BARTD). The research, sponsored by National Science Foundation Grant No. 0SS76-14230, began in summer 1976 and is scheduled to be completed by summer 1978.

A case history is being developed which chronicles events revolving around three engineers whose concern about the potential safety of BART's automatic train control system led them to actions which resulted in their dismissal. Ultimately, a number of diverse organizations (including the California Society of Professional Engineers, NSPE, IEEE, the California State Legislature, and the Superior Court of Alameda County, State of California) became involved in the case. Although the case has received widespread publicity, especially in this publiction, no complete scholarly study has been made.

Researchers at Purdue have gathered approximately 600 documents relevant to the case and conducted approximately 20 hours of interviews with people involved on all sides of the issue. This is the first time anyone has been successful in gathering viewpoints of engineers, BART management, BART Board of Directors, and people involved in various professional societies.

Three types of materials will be developed from this research: (1) a set of case study materials suitable for use in classroom situations; (2) a monograph for general readership; and (3) a series of articles for publication in scholarly and popular publications and presentation at various conferences. These materials can be used in the fields of engineering, management, sociology, communications, and other disciplines.

Robert M. Anderson, Ball Brothers Professor of Engineering at Purdue University, is the Project Director and one of the principal investigators. He is a senior member of IEEE, a Professional Engineer and is currently the director of the continuing engineering program at Purdue.

Co-principal investigators are: Leon E. Trachtman, Associate Dean, School of Humanities, Social Science and Education; Robert Perrucci, Professor of Sociology; and Dan E. Schendel, Associate Professor of Industrial Management, Krannert Graduate School of Industrial Management. Dean Trachtman, a former science writer, is also Professor of Communication. Professor Perrucci specializes in the study of complex organizations and social problems. Professor Schendel's research interests include policy and planning, with a major emphasis on the effectiveness of strategic decision-making.

Lea Stewart, graduate research assistant, is working toward a Ph.D. in interpersonal and organizational communication.

Sandra S. Dukes, Attorney at Law, and James Otten, Assistant Professor of Philosophy, are working with the project as consultants.

[A more detailed discussion of this research project will apper in a future issue of *Technology and Society*.]

REPORT FROM SWISS SECTION

The "Working Group for Society and Technology" of the Swiss Section of the IEEE held its third open meeting at the ETH (Swiss Federal Institute of Technology) in Zürich on April 27, 1977. The group has found an effective working mode: the two subgroups meet separately a number of times for informal discussion, and then together twice a year for more formal presentations open to the public.

The Subgroup on Energy devoted themselves to discussion of various topics dealing with saving energy on a national basis. R.W. Peter discussed an overall energy saving plan for Switzerland with particular focus on more effective use of energy by industry. J. Tödtli discussed saving energy in the context of residential heating. These two talks indicate that in Switzerland the anticipated 2.5% growth of energy consumption per year could be met through 1985, by making use of waste energy through the installation equipment which could be amortized within this period. H. Koller reported on energy requirements for transportation with the conclusion that 25% of the present level of energy consumption could be saved without sacrifice of the present living standard. S.K. Sarkar discussed several of the possible results of trying to substitute telecommunications for travel.

The Subgroup on Communication presented two talks on the theme of Human Rights and Communication. E. Biefer discussed a number of the technical and legal issues involved in the protection of privacy. The rights and obligations of data bank owners and data bank subjects to establish and access such data banks were discussed. D. Kramer discussed the Human Rights issue from the point of view of electronic mass media. The rights and obliga-

tion carriers or distributors were considered. These issues are made more complex by the technology which makes CATV and TV via satellite possible.

The Working group intends to offer some of the results of these discussions for publication at a later date.

H. Rudin

NOTICE TO READERS

To cover the costs of publishing TECHNOLOGY AND SOCIETY, CSIT and the Technical Activities Board have decided to charge a subscription fee of two dollars a year (4 issues) starting in 1978, payable when you pay your regular IEEE membership dues. For the convenience of readers, IEEE members currently receiving TECHNOLOGY AND SOCIETY will automatically be included on the mailing list (and charged the $2 for 1978) unless they cross out the entry "CSIT" on their 1978 Membership Renewal Notice and deduct the $2 from their remittance. Detailed instructions for terminating subscriptions are contained in the Periodicals brochure which is enclosed with your Membership Renewal Notice.

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The staff of TECHNOLOGY AND SOCIETY thank you for your interest and support. Please contact me if you have any questions or difficulties regarding your subscription.

Frank Kotasek Jr., Ed.

CSIT MEETING, MARCH 11, 1978

The next meeting of CSIT will be held on Saturday, March 11, 10am to 3pm, in New York City (precise location not yet determined). CSIT meetings are open to all IEEE members, and we hope you will take this opportunity to become better acquainted with us and with our activities. Light lunch will be provided. If you plan to attend (and to find out the precise location of the meeting), please notify Ms. Joan Breslin, IEEE, 345 East 47th Street, New York, NY 10017, (212) 644-7887.

REBUTTAL

APPLICATION OF SYSTEMS ENGINEERING TO SOCIETAL PROBLEMS, AND THE QUALITY OF LIFE

One still hears comments that the systems approach could solve society's problems, but "I wouldn't want to live in such a society" (T & S, September 1977, p. 17). This opinion is not justified. Systems engineers do not want to design bad systems, societal or otherwise. The goal in solving societal problems is to attain a society in which we will all want to live.

The first step in solving societal problems is to determine the objectives which the society desires. The function of the systems engineer in this step is not to impose his own values, but as best as possible to ascertain the values of the public whom he serves. In this process, he will make use of the tools that society has developed for reaching consensus on values. In other words, whatever objectives are postulated, they will be the best statement of objectives that can be devised.

Once the objectives have been postulated, the systems engineering task is to find a solution that satisfies the objectives as nearly as possible. Hence, to the best of society's ability, the solution attained by the systems approach is the one that best meets society's objectives, and the one in which members whose values contributed to the objectives most want to live.

G. Rabow

[Ed. note: Dr. Rabow is chairman of CSIT's Working Group on Systems Engineering and Public Technology.]

CORRECTION

The response of Dr. Richard E. Merwin to item 2a of "Questions for Candidates" [T&S, September 1977, p.8] should have read as follows:

> "The clause should be altered to read Professional Engineer (as it is now recognized in most states). The title of engineer is descriptive of one's occupation and background and not of one's qualifications to sign contracts and other legal documents as a specialist of some kind."

The word "not" was inadvertently omitted from the second sentence. I regret the error. --Ed.