maintain tentative status for one year, then vote the rules as permanent.

Through quick, skillful, and persistent effort a thorough study of those rules by the experienced A.O.C.S. group revealed many to be unacceptable. These findings were passed on by the A.O.C.S. to N.F.P.A. with the suggestion that the rules be held tentative for at least another year to permit further study. The suggestion was accepted, the rules were revised, and a re-study by the A.O.C.S. was made. To my knowledge N.F.P.A. 36 is still tentative but is immeasurably improved. I am sure that each society realizes that a distinct benefit has resulted.

THERE ARE numerous jobs to do. Here are a few illustrations. All doubt should be eliminated about flashlights. Should we pay extra money to have them underwriter-approved? Considerable study has been given to nonsparking tools. Should we spend extra money for them? Are they beneficial? How many air changes should be provided in the extraction area? What is the definition of the term "Safe Distance?" How do individuals effectively and confidently apply it? Could the Safety Committee clarify this? I am sure it could.

Getting into the laboratory phase for just one illustration, how do you measure solvent in extracted meal? Most of you know there have been numerous accidents from solvent in meal. Our good friend Ed Gastrock has set as one of his goals the development of a test for solvent in meal so that buyers, sellers, or handlers of meal will have confidence in its safety. Many of you have seen the recent summation of the Laboratory questionnaire by R. M. Starr, and you could not help but be impressed by the work involved as well as the interest shown. Earlier questionnaires which resulted in equal enthusiasm were conducted by Norm Witte and Walt Bolens. Requests by individuals for further studies covering more than a dozen subjects are on record.

And there have been many others. I hesitate to mention individuals for fear of offending some through omission. I have not seen a questionnaire that did not get a remarkably high percentage of participation.

Certainly those of us who have been in close association with this program see a great change in the freedom with which information is given. There is a big desire to be helpful, a feeling that "by relating our experience maybe we can help others avoid a misfortune." This help is now volunteered where in former years we had to prod for it. I cannot think of a better atmosphere for success. Considerable progress is being made about "what to do and be safe when straightening up after a misfortune." Again the freedom with which experiences are being discussed is an immeasurable help. So far I know of no set rule as to how to proceed. However, after such and such happens, I now proceed with much greater confidence if I have heard some one relate a similar experience. It is as simple as this: we have all been taught how to use a fire extinguisher, therefore we use it with confidence.

Now where are we going? You people will decide. Have the results been worth the effort? It seems that participation through questionnaires, the consistent increase in attendance, and the fact that your companies are allowing added travel for such participation are strong evidence that this activity is worthwhile. This accomplishment is greatly enhanced through the freedom exercised in giving information about experiences. Reflect for a moment or two how many man-years of experience are present at these meetings, experience which reaches all phases of the extraction industry. Surely this A.O.C.S. safety program will continue to grow and perform a useful and valuable service to the entire industry.

Solvent-Extraction Plant Protection

E. J. SESTAK and A. T. SCHRAGE, Factory Insurance Association, Chicago, Illinois

DEVELOPMENT of solvent extraction for recovering vegetable oils from various grains and other materials has supplemented mechanical removal to obtain a more uniform and higher quality of product and a more economical process. The transition from mechanical expelling to solvent extraction introduced the hazard of large quantities of solvents in addition to the normal handling of grains and high-flash-point oils. The relatively nonhazardous chlorinated hydrocarbon solvents have not proved satisfactory, in general, for several reasons. Practically all extraction now is accomplished with low-flash-flammable solvents which, with the grain handling and oil storage, pose major fire-protection problems.

Basically the modern solvent-extraction plant for obtaining vegetable oils from grains involves a grain-preparation process, a solvent-extraction unit, and finished oil-storage facilities. The grain preparation introduces a potent dust-explosion hazard while the solvent-extraction unit presents a severe flammable vapor hazard. These features point to the need for locating the entire operation on an adequate plot of ground well distant from other properties both to minimize damage from the operations and exposure to the operations from other activities. The latter is of particular concern since ordinary residential, commercial, and manufacturing activities do not contemplate safeguards against the hazard of flammable solvents or the vapors which could be discharged from the extraction unit. Location of plant should also give due consideration to topography of the ground, prevailing winds, and possible high water, flood conditions, or earthquake. Further, the entire extraction plant also should be well fenced to prohibit access by unauthorized persons who are not familiar with grain dust and flammable liquid hazards.

When feasible, the extraction plant should be located where good public fire department protection is available and the city fire department should be made cognizant of the operation and hazards involved to permit intelligent fire fighting if necessary.

Segregation of major components within the extraction plant proper is necessary to reduce hazards and minimize interruption to operations. Grain-storage facilities and preparation buildings should be detached from each other and from the extraction unit. Boiler house and maintenance shop buildings, containing open fires which provide a potent source of ignition for flammable vapors, should receive special consideration when located with respect to operating buildings or tank car unloading sites. While good separation of adjoining components can be effected to some degree by providing reinforced concrete explosion-resisting walls between the dust and vapor hazard areas and other general-use sections, open-space detachment of all major units is much more preferable.

The housing or enclosing of the hazardous grain-preparation and solvent-extraction units is largely dependent on the location of the plant. Preferably processing equipment should be located in the open as is always possible in the southern latitudes and to some degree in the northern climates. Where necessary to enclose these units, building should be of complete noncombustible construction, having rigid steel frame design, with light noncombustible panel wall and roof construction, or with maximum window area in buildings of heavier design, all with the view of obtaining explosion-relief venting, approaching 1:25 ratio. Experience has proved that this type of design relieves explosion forces with minimum damage to buildings and equipment and results in a reduced time-interval to restore the plant to operation. Other auxiliary buildings may be of conventional design, preferably of noncombustible construction.

BULK STORAGE and the handling of grains contemplate the use of sizable fire resistive or noncombustible silos. This bulk storage is not normally considered a feature of the solvent-extraction process. However various features of this storage should be safeguarded in accordance with accepted practices for the storage and handling of grains.

Bulk storage of solvents and the solvent unloading site should be distant from all processing and auxiliary buildings and other possible sources of ignition. Bulk-solvent storage should preferably be in buried tanks. Where space permits above-ground storage, tanks should be properly enclosed with dikes and provided with adequate flame-arrester-equipped vents. Transfer pumps and pipe system should be safely installed against mechanical injury.

The Preparation Building contains such processes as grain conditioning, milling, cracking, and flaking preparation prior to extraction. After oil extraction has been completed, spent meal at times also may be toasted, milled, etc., in this structure. These operations introduce potent dust-explosion hazards. To minimize possible difficulties from this source, process equipment as far as practical should be of noncombustible construction; equipment should be tight to prevent escape of air-borne dust and should be operated under slight negative pressure; individual motor drives are preferable to belt drives which produce static changes; provision of magnetic and pneumatic separators for removal of tramp iron and other foreign materials are necessary for head of grinders, flakers, and possibly other points, depending on process arrangement. Dust-removal equipment should be installed to remove floating dust from belts, elevators, screens, bins, cracking and flaking rolls, and other points of origin where necessary. This dust-removal equipment should be independent of any provided for the storage facilities and should be arranged to convey dust to metal cyclones or separators safely located out of doors. Electrical equipment exposed to dust hazard should be of the approved Class 2, Group-G, hazardous-location type, installed as outlined in the National Electrical Code. Heating should be indirect steam or hot-water system; use of portable electrical cords and open flames should be prohibited.

The Extraction Building operations are in two principal phases, solid and liquid. The solid phase comprises the flake supplied to the extractor and the spent meal after extraction of oil. The liquid phase comprises the solvent used in processing, the extracted oil, and mixtures of both. Operation of an extractor unit employing low-flash-flammable solvent presents more than the usual hazard because of this solid-liquid combination where the introduction and removal of solid matter from the solvent-laden extractor is of major importance. In addition to the extraction unit both solid and liquid phases receive additional treatment in the Extractor Building to obtain end-products.

Various types of extractor units have been developed since the early 1930's when moderate-to-large-scale solvent-extraction units were introduced in this country. Improvement and refinements have been incorporated as field and operating experience dictated. However basically all units must have oil-laden flakes introduced into and spent meal removed from the unit. Normally flakes are conveyed from the Preparation Building to the Extraction Building by means of a closed spiral conveyor which discharges material, through a seal arrangement, into the extractor. Several types of seals are employed, but regardless of type it is essential that the solid material form a vapor seal at the entrance to the extractor. Spent meal leaving the extractor through the exit seal may contain 20% to 30% solvent, which is recovered on direct passage through multiple sections of steam-heated desolventizers, dryers, etc., and the resultant solvent free meal is then handled as economic conditions warrant.

Removal of oils from the various oil-bearing grains and seeds is accomplished by handling materials in baskets, buckets, or conveyor flight moving either in the vertical or horizontal plane inside the extractor while operating at a temperature of approximately 140°F. while solvent or solvent-oil mixture is introduced countercurrent to the material flow. The resulting oil-solvent mixture is withdrawn for further separation in a steam-heated stripper still.

IN ALL extraction processes the operations are contained in a totally enclosed system. The solvent is pumped to the extractor through a closed-pipe system from a nominal capacity work tank in the Extraction Building or direct from buried or distant above-ground storage tanks. Since the recovery of solvent is a prime economic factor, all processing equipment is attached to common vapor-collector and condensor equipment prior to atmosphere venting. This feature normally results in negligible flammable-vapor discharge in proximity to operations and surrounding areas.

Relatively large quantities of low-flash-flammable solvent used in the Extraction Plant present a major fire and severe vapor-explosion hazard, requiring the utmost in protection to safeguard operations or hold possible damage to a minimum. Observations outlined above with respect to building location and construction should be observed. Prohibition of all smoking and open flames in the extractor area is imperative. Where necessary, building heat should be from indirect steam or hot-water systems. Various process equipment and interconnecting lines should be maintained vapor tight, and constant attention directed to packing glands on valves, pumps, etc., all with view of minimizing solvent leakage into the process area.

Continual checking of flake and spent meal seals, together with possible liquid seals, on operating equipment is most important. Sight glasses on operating equipment should be of the enclosed high-pressure type to avoid accidental breakage and resultant discharge of solvent or oil. Adequate low-level mechanical ventilation for enclosed buildings is necessary to maintain an atmosphere free of solvent vapors. Class 1, Group-D hazardous location electrical controls are required throughout the extraction-processing area and in the general vicinity of activity because of the possible presence of vapor; ordinary hazard type of major electrical controls may be employed when installed distant from and elevated above vapor range on grade or housed in a solvent-free, air-pressurized structure. Direct motor drives are recommended for operating equipment to eliminate static-producing belts. Good positive continuous grounding should be provided for building all processing equipment, transfer lines, conveyors, etc. Reliable condensor water-supply is essential together with an auxiliary gravity supply of sufficient capacity safely to shut down all operating equipment; normally this would call for water volume to supply all condensor requirements for at least a 30-min. interval. Installation of an approved type of constant sampling and registering type of flammable-vapor indicator is recommended at all points from which solvent vapors may be discharged under abnormal operation of the extractor, at auxiliary units, and at pumps subject to leakage on account of normal wear. Provision of visual and audible alarms for indicating loss of condensor water pressure and excess steam to operating equipment are valuable aids for the operating personnel. Complete interlocking of process flow is essential automatically to shut down all flow of materials and processing on the upstream side of any impaired operating unit.

FIRE PROTECTION for the Preparation Building and auxiliary structures normally consists of a conventional fixed-temperature automatic sprinkler system.

Protection of the Extraction Building requires a special hydraulically designed open-head sprinkler system together with additional directional spray sprinklers for some processing units, all under control of a deluge valve operating through a rate-of-rise release system. When properly designed and supported from principal structural members, such a system will withstand explosions and provide excellent fire control. Since all sprinklers on an open-head sprinkler system discharge water simultaneously, the problem of water supply is of paramount importance, particularly when volumes in the range of 2,000 to 5,000 G.P.M. may be needed at pressures varying from 50 to 100 lbs. In addition to the water supply for this protective equipment, substantial volumes are also necessary for hose streams. Where available, fire-protection-system water supplies may be obtained from the city water works system after all factors of the city system are analyzed and necessary tests are conducted at the plant site. Where the city water system has adequate volume but at low pressures, the latter deficiency could be improved by the installation of automatic booster pumps in the city line serving the plant. When the city supply is not available, private supplies are necessary. These would consist of a minimum 100,000-gal. gravity tank on not less than 100-ft. tower together with adequate automatic fire-pump capacity taking suction from ample-size reservoirs. The fire pump and reservoir capacities are determined by the total demand established by the hydraulically calculated system in the Extraction Building with additional allowance for hose streams. Specifically the water supply for solvent-extraction plants is based on an individual review of each property. Adequate drainage is of particular importance for the Extraction Building to dispose of the low-flash solvent and water from the fire protection system. Such drainage must include a properly trapped interceptor sump for separating solvents and oils prior to passage of water to discharge source.

Provision of approved type of hand extinguishers, small hose connections inside of buildings, and standard watchman service at nights and inoperative day periods are needed to supplement the major fixed protection in the property.

Notwithstanding all the protective features incorporated into the solvent-extraction plant, the safe operation of such a unit is still in the hands of the management and operating personnel. Good housekeeping and control of all ignition sources require constant attention. Repairs and alterations require purging and inerting prior to any cutting or welding operations. Emergency conditions require a well-trained operating force to bring the processes to a safe stand-still condition. Extreme care is required on start-up or shut-down of extraction units.

Attention is again directed to the continuous conveyor connections between the Extraction Building and other structures even though building separations are provided by explosion-resisting fire walls or some intervening space. These connections provide a direct path for vapor travel from the extraction units to the other areas. It is imperative that positive, solid meal seals be established in these conveyor connections together with the provision of means for detecting possible vapor passage.

The general good over-all fire and explosion experience in solvent-extraction plants is an indication of the present high caliber operating and management supervision. This must continue to maintain a safe operation of these plants.

Safety as We Look at It

J. I. MASLON, Honeymead Products Company, Mankato, Minnesota

THE HUMAN SIDE OF SAFETY is something that we call "safety consciousness" and is considered equal to if not more important than technical safety. The work done by the A.O.C.S. and the N.S.P.A. in conjunction with the committee on flammable-liquid plants is very commendable. Solvent extraction of vegetable oils is a new industry in this country, and it is a rapidly expanding one. Safety pioneering is badly needed, and the tentative standards for solvent-extraction plants represents a sizeable