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December 4, 2007

Ms. Ann Cole, Director
Commission Clerk and Administrative Services
Florida Public Service Commission
2540 Shumard Oak Boulevard
Betty Easley Conference Center
Room 110
Tallahassee, FL 32399-0850

HAND DELIVERY

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COMMISSION CLERK

Re: Docket No. 070183-WS

Dear Ms. Cole:

Enclosed for filing on behalf of Aqua Utilities Florida, Inc. ("AUF"), are the original and fifteen copies of the Prefiled Direct Testimony and Exhibits of John F. Guastella.

Please acknowledge receipt of these documents by stamping the extra copy of this letter "filed" and returning the copy to me.

Thank you for your assistance with this filing.

Sincerely,

Kenneth A. Hoffman

KAH/rl
Enclosures
cc: Rosanne Gervasi, Esq., with enclosure, via hand delivery
Stephen C. Reilly, Esq., with enclosure, via hand delivery
Martin S. Friedman, with enclosure, via U. S. Mail
Kimberly A. Joyce, Esq., with enclosure, via U. S. Mail

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BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In Re: Proposed Adoption of) Rule 25-30.30.4325, F.A.C.,) Water Treatment Plant Used & Useful)	Docket No. 070183-WS Filed: December 4, 2007

DIRECT TESTIMONY

OF

JOHN F. GUASTELLA

ON BEHALF OF

AQUA FLORIDA UTILITIES, INC.

Q. Please state your name and business address.

A. John F. Guastella, Guastella Associates, Inc., 6 Beacon Street, Suite 410, Boston, MA 02108.

Q. Please describe Guastella Associates, Inc.

A. Guastella Associates, Inc. provides utility management, valuation and rate consulting services to both regulated and unregulated utilities.

Q. How long have you been involved in utility regulation and rate setting?

A. My entire professional career has been in the field of utility regulation and rate setting: first as a regulator for 16 years and then as a consultant for the last 29 years.

Q. Have you attached to this testimony a summary statement of your education and experience?

A. Yes.

Q. What is the nature of your involvement in this proceeding?

A. Guastella Associates, Inc. has been employed by Aqua Florida Utilities, Inc. ("Company" or "Aqua Florida") to participate on its behalf in this proceeding.

Q. Have you participated in the meetings and conferences conducted by the FPSC regarding this rule making, and have you reviewed the FPSC Staff's draft Rule 25-30.30.4325, F.A.C. Water Treatment Plant Used and Useful?

A. Yes.

Q. Does the Company support the adoption of the proposed rule?

A. Yes. The purpose of the proposed rule is to establish manageable formulas with which to establish used and useful percentages for certain utility facilities that are reasonable and intended to significantly reduce the costly adjudication of such issues in rate cases, particularly for smaller water utilities.

Q. What are the general items that you would modify?

A. I am recommending modification to the areas of maximum day demands, unaccounted for water and fire flows.

Q. How would you define "used and useful"?

A. Used and useful is a regulatory rate setting term that is applied to the cost of utility assets that are necessary to provide service to customers in order to economically meet their demands on a continuous basis. Accordingly, the cost of facilities that are used and useful would be included in rate base for rate setting purposes.

Q. How are used and useful determinations applied in setting rates?

A. Utility rates include components of revenue requirement that provide an opportunity to earn a return on investment in utility facilities that are used and useful, as well as a recovery of the cost of those assets through depreciation allowances. The level of the cost of assets that are determined to be used and useful also has a rate setting impact on property and income taxes.

Q. Are the used and useful adjustments that are typically made in Florida common in other states?

A. No. However, the historical characteristics of Florida's water and wastewater utilities and rate setting process are also different from those of other states. Florida's water and wastewater utilities have generally been created in connection with real estate developments that take long periods of time before completion. Real estate development projects in other states are typically phased in or completed in shorter time frames. In addition, Florida's rate setting has established Service Availability Charges that are more extensive than, or even non-existent, in other states. In my opinion, therefore, it is appropriate for the FPSC to establish used and useful rules that balance the interests of the customers of developer related utilities and the affiliated developers. I must also add that balancing those interests in a rule with specific formulas requires a focus on some basic rate setting considerations. The cost of utility facilities is determined according to engineering design criteria, the goal of which is to ensure safe and adequate service on a continuous basis. The engineering design standards are not established according to rate setting procedures or used and useful calculations. Water systems are designed to meet demands that include a factor of safety or cushion so that when fully developed, it is expected that the capacity of the facilities will be greater than the actual demands. Thus, used and useful calculations should not ignore sound engineering design criteria. The rates should also recognize economies of scale and prudency of investment.

Q. What specific modifications do you recommend with respect to maximum demands?

A. The maximum demands, either maximum day or peak hour, should not be limited to a rate setting test year. Rate setting test years are not a consideration in any engineering design criteria or those established by environmental regulators. As a practical matter, and in actuality, maximum demands can and have occurred prior to rate setting test years. If it is recognized that the costs a water utility incurs for facilities to meet maximum demands is a valid cost to provide adequate service, as should be the case, then that level of cost for capacity and facilities should not be reduced because a lower absolute demand or demand per ERC occurred during the rate setting test year. Using test year demands when previous demands were higher is simply denying a cost the utility had to increase in order to adequately provide service to existing customers.

Q. Do you have any other recommendations regarding the maximum demands?

A. Yes. The proposed rule would preclude the use of maximum day or peak hour demands if there is an unusual occurrence on that day, in which case the rule provides for the use of the average of the 5 highest days within a 30 day period (which is understood to be any calendar month). I recommend eliminating the provision to use a maximum 5 day average, and instead use the next maximum day demand that had no unusual occurrence. I am not aware of any engineering design criteria that would use an estimated 5 day average. Accordingly, the construction cost of water utility facilities is not based on a 5 day average demand but the maximum day demand. In fact, the engineering design would assume a maximum day demand in excess of the actually expected maximum day in order to provide a factor of safety or cushion in order to assure that there is ample capacity to meet unforeseen circumstances. In addition, the use of a 5 day average produces costs that are less than the actual cost of facilities that were needed on the days when the demand was higher than the other days included in the average. The use of a 5 day average therefore, denies the cost of serving existing customers, let alone growth.

Q. What do you recommend with respect to unaccounted for water?

A. I do not believe it is appropriate to make adjustments to demands for unaccounted for water, because eventually all systems experience increasing levels of unaccounted for water as systems age. The more appropriate regulator response is to make a cost-justified decision as to whether the cost to correct the problem is worth the benefit. However, because the proposed rule contains language in section (Section 10) that provides for the handling of special circumstances, I am not proposing a change to the formulas with respect to unaccounted for water.

There is, however, a correction that must be made to the arithmetic described in (1) (e) of the proposed rule. Unaccounted for water is a percentage of the total amount of water delivered to the water system. If the accounted for usage is known or estimated, and assuming an acceptable unaccounted for level of 10%, the unaccounted for quantity is properly calculated by dividing the known usage by 0.9 in order to determine the quantity delivered to the system. Then, the calculated amount of water delivered to the system should be multiplied by 10% in order to determine the unaccounted for quantity. Accordingly, I recommend changing the language in Section (1) (e) to read, "Excessive unaccounted for water (EUW) is finished potable water produced (delivered to the system) that exceeds 10% of that production quantity." There is no need to complicate the rule with the specific arithmetic, the correct use of which should be left to the party responsible for the calculation.

Q. What is your recommendation with respect to fire flow?

A. Section (1) (c) provides for fire flow demands to be added to peak demands at "a minimum of either the fire flow required by the local governmental authority or 2 hours at 500 gallons per minute." This provision assumes that the local governmental authority's fire flow requirement is consistent with how the entire water system should have been designed. It has been my experience however, that local governmental authorities recommend a rate of flow per hydrant. Moreover, the local governmental authorities do not necessarily have the expertise to establish design criteria for the comprehensive water system, nor do they. It is more appropriate and in my experience more accurate to rely on engineering design criteria and recognized standards in order to establish the fire flow requirements. The design of water systems, and their cost, with respect to the provision of fire protection service is more properly based on engineering considerations that take into account the requirements of the Insurance Service Organization (ISO) and its predecessor, the National Board of Fire Underwriters (NBFU). The ISO's fire flow requirements relate to single structures, and when the formulas provided are used, the results could be great than those of the local governmental authority, which may be limited to individual hydrants. The NBFU has published fire flow requirements for complete water systems that take into account the population of the community being served, not just individual hydrants or buildings. The proper engineering design of water systems should not only meet local requirements but, of equally if not more importance, also meet greater demands if necessary to provide adequate fire flows, throughout the service area.

Q. How would you modify Section (1) (c)?

A. I would simply change the last phrase to read, "where fire flow is provided, <u>an appropriate fire flow</u> or a minimum of either the fire flow required by local governmental authority or 2 hours at 500 gallons per minute."

Q. Have you provided exhibits containing ISO, NBFU and AWWA publications or sections of publications setting forth fire flow requirements and/or calculations?

A. Yes. I have provided an ISO publication as Exhibit JFG-1, entitled, "Guide for Determination of Needed Fire Flow," Exhibit JFG-2 containing sections of a publication by the NBFU entitled, "Standard Schedule for Grading Cities and Towns of the United States with reference To Their Fire Defense and Physical Conditions," and sections of the "AWWA Water Rates" manual, 4th edition.

Q. What information is provided by these publications?

A. They provide guides and formulas for calculating fire flow requirements, all of which indicate that except for the very small water systems serving only modestly sized residential houses, the fire flow requirements that a properly designed water system must meet could be significant for individual buildings, and must take into consideration the use of multiple hydrants, and the need to meet fire flow demands at every location throughout the system, and in some cases meet coincidental fires.

Q. Have you reviewed the testimony of Mr. Andrew T. Woodcock on behalf of the Office of Public Counsel?

A. Yes.

Q. Do you disagree with any of Mr. Woodcock's recommendations?

A. Yes.

Q. Do you agree with Mr. Woodcock's recommendations with respect to high service pumps?

A. Partially. I agree that high service pumps should be separately identified as to cost and that their percentage of used and usefulness should not be the same as for storage facilities. I disagree that the only additional data that would be required is the capacity of the high service pumps. For those water systems that have multiple high service pumps (many small systems do not), the capacity of those pumps alone is not sufficient to establish their used and useful percentage. Typically, high service pumps connect to a common transmission main, and when two or more pumps are operated at the same time, they pump against pressure, resulting in flow rates that are less than their respective rated capacity. Operators may also alternate the use of multiple pumps, depending on demands, and not use all at the same time. Accordingly, in most cases there is no need to perform a used and useful analysis of pumps -- in most instances it can be determined that they are 100% used and useful simply by observation. In instances where used and useful may be an issue with respect to high service pumps, a formula that only provides for the ratio of demands to capacity is not sufficient. The calculation it would have to take into account judgments and analyses that are not readily convertible into a formula.

Q. Do you agree with Mr. Woodcock's recommendation to change the definition of peak demands for systems with storage?

A. No. The requirement that water systems must be designed to meet the greater of the maximum day plus fire demands or the peak hour demand, does not assume that only storage facilities are needed to meet the potential fire demands which may occur at any point in the system. Storage is provided for equalization, fire protection and emergencies. Depending on the size of the system, storage facilities may be located at various locations in the distribution system, not only at the source of supply or treatment plant. In a fire event, all facilities are generally used at their full capacity, not just storage facilities, in order to provide fire flows and general demands, as well as the replenishment of stored water.

I am aware of actual fires that were experienced in systems of two of my clients in Florida; Marco Island and Palm Coast utilities. The fire of Marco Island was at a single 5 story building and the fire at Palm Coast was a forest fire that consumed about 100 homes. In each case, all storage capacity was used and every available source, treatment and pumping facility was operated at full capacity. Aside from the fact that the design criteria with respect to fire flows and duration were exceeded, the need to recognize the use of all facilities, not just storage, is necessary and should be relied upon for fighting fires.

Q. Do you agree with Mr. Woodcock's recommendation to revise the definition of peak demand for storage?

A. No. One objective of the proposed rule is designed to establish reasonable used and useful criteria that eliminate unnecessary and costly controversy. As I previously testified, storage facilities are designed with capacity for equalization, fire demands and duration, and emergencies. The design of storage capacity will vary from system to system, as well as from consultant to consultant. The proposed rule using maximum day is, in my opinion, a reasonable criteria for a used and useful rule.

Q. Do you agree with Mr. Woodcock's recommendation to provide documentation of account for water?

A. No. Mr. Woodcock does not specify the type of documentation that would be acceptable. Water used for flushing, fire fighting, line breaks and other uses not mentioned, are not routinely measured or metered. They are only determined based on estimates. The basis for a utility's estimates of such items is readily reviewed in the normal course of a rate investigation as to the reasonableness of the estimates. Mr. Woodcock's recommendation for unspecified documentation merely creates an excuse to eliminate reasonable estimates that are readily examined by experienced engineers or operators.

Q. Do you agree with Mr. Woodcock's recommendation to remove paragraph (2), and remove subparagraphs (a) (b) and (c) of paragraph (4)?

A. No. These paragraphs are essential if the proposed rule is to have any value in providing a reasonable balance in making a used and useful adjustment for developer created utilities. As I previously testified, the design standards require capacity that is greater than expected when actual demands are realized -- in order to include a factor of safety or cushion to assure adequate service. The utilities incur costs for facilities based on design capacity not actual use. The proposed rule makes no specific allowance for the portion of capacity that represents the safety factor or cushion. At some point, however, prudence and economies of scale are considerations that must be recognized within the context of the rule. In addition, systems that are complete or fully developed and single well systems must be considered 100% used and useful, otherwise utilities will never be able to achieve the cost of serving their existing customers -- and the used and useful adjustments would no longer provide a balance between the customers and the affiliated real estate developer utility but simply deny an unavoidable cost that was necessary to provide adequate service.

Q. Do you agree with Mr. Woodcock's proposed change to paragraph (3)?

A. No. The change is not necessary. This paragraph recognizes that water utilities should have the ability to provide alternative calculations, as part of its burden to justify its proposed rates. Any party to the rate proceeding has the right to address every aspect of the utility's filing.

Q. Do you agree with Mr. Woodcock's recommendation to change paragraph (6), subparagraph (b) to express firm reliable capacity based on 24 hours instead of the 12 hours in the proposed rule?

A. No. The proposed rule, using a 12 hour period, provides a reasonable balance that recognizes typical consumption characteristics in terms of time periods, and recognizes the typical practice of resting wells to allow time for recharge.

Q. Do you agree with Mr. Woodcock's proposed revision to the use of a factor of 2 times the maximum day in order to estimate the peak hour?

A. No. The use of a factor of 2 times the maximum day in order to estimate the peak hour is typically recognized for design as well as cost allocation studies, particularly for predominately residential customers.

Q. Do you agree with Mr. Woodcock's recommendation to eliminate paragraphs (10) and (11)?

A. No. The proposed rule identifies in paragraphs (10) and (11) common issues that should be considered in every used and useful analysis. If unaccounted for water is part of the proposed default formulas, then it is important that the rule recognize other factors that address unaccounted for issues. Also, the change in flows due to such causes as conservation or number of customers, and other factors, are also common considerations that are important to recognize so that the rule includes flexibility to address issues beyond those included in restrictive formulas.

Q. Do you have any other comments?

A. While I have covered specific recommendations of Mr. Woodcock to which I disagree, there are others that I did not directly discuss, because I agree with his recommendations or because if my own recommended revisions to the proposed rule are different from his and there is no need for additional discussion, or because they will not have a significant impact on the proposed rule.

Q. Does that conclude your testimony at this time?

A. Yes.

Docket No. 070183-WS
Attachment 1

QUALIFICATIONS

&

EXPERIENCE

JOHN F. GUASTELLA

PROFESSIONAL QUALIFICATIONS AND EXPERIENCE
of
JOHN F. GUASTELLA

B.S., Mechanical Engineering, Stevens Institute of Technology, 1962, Licensed Professional Engineer.

Member:

American Water Works Association, Lifetime Member
National Association of Water Companies
New England Water Works Association, Lifetime Member

Committees:

AWWA, Water Rates Committee (Manual M-1, 1983 Edition)
National Association of Regulatory Utility Commissioners (NARUC) and NAWC, Joint-Committee on Rate Design
NAWC, Rates and Revenues Committee
NAWC, Small Water Company Committee

Mr. Guastella is President of Guastella Associates, Inc., which provides management, valuation and rate consulting services for municipal and investor-owned utilities, as well as regulatory agencies. His clients include utilities in the states of Alaska, Arkansas, California, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Maine, Maryland, Massachusetts, Missouri, Michigan, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Pennsylvania, South Carolina, Texas, Rhode Island and Virginia. He has provided consulting services that include all aspects of utility regulation and rate setting, encompassing revenue requirements, revenues, operation and maintenance expenses, depreciation, taxes, return on investment, cost allocation and rate design. He has performed depreciation studies for the establishment of average service lives of utility property. He has performed appraisals of utility companies for management purposes and in connection with condemnation proceedings. He has also negotiated the sale of utility companies.

Mr. Guastella served for more than four years as President of Country Knolls Water Works, Inc., a water utility that served some 5,500 customers in Saratoga County, New York. He also served as a member of the Board of Directors of the National Association of Water Companies.

Mr. Guastella has qualified and testified as an expert witness before regulatory agencies and municipal jurisdictions in the states of Alaska, California, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Maryland, Massachusetts, Missouri, Montana, Nevada, New Hampshire, New Mexico, New Jersey, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, South Carolina, Texas and Virginia.

Prior to establishing his own firm, Mr. Guastella was employed by the New York State Public Service Commission for sixteen years. For two years he was involved in the regulation of electric and gas utilities, with the remaining years devoted to the regulation of water utilities. In 1970, he was promoted to Chief of Rates and Finance in the Commission's Water Division. In 1972, he was made Assistant Director of the Water Division. In 1974, he was appointed by Alfred E. Kahn, then Chairman of the Commission, to be Director of the Water Division, a position he held until he resigned from the Commission in August 1978.

At the Commission, his duties included the performance and supervision of engineering and economic studies concerning rates and service of many public utilities. As Director of the Water Division, he was responsible for the regulation of more than 450 water companies in New York State and headed a professional staff of 32 engineers and three technicians. A primary duty was to attend Commission sessions and advise the Commission during its decision making process. In the course of that process, an average of about fifty applications per year would be reviewed and analyzed. The applications included testimony, exhibits and briefs involving all aspects of utility valuation and rate setting. He also made legislative proposals and participated in drafting Bills that were enacted into law: one expanded the N.Y. Public Service Commission's jurisdiction over small water companies and another dealt specifically with rate regulation and financing of developer-related water systems.

In addition to his employment and client experience, Mr. Guastella served as Vice-Chairman of the Staff-Committee on Water of the National Association of Regulatory Utility Commissioners (NARUC). This activity included the preparation of the "Model Record-Keeping Manual for Small Water Companies," which was published by the NARUC. This manual provides detailed instruction on the kinds of operation and accounting records that should be kept by small water utilities, and on how to use those records.

Each year since 1974 he has prepared study material, assisted in program coordination and served as an instructor at the Eastern Annual Seminar on Water Rate Regulation sponsored over the years by the NARUC in conjunction with the University of South Florida, Florida Atlantic University, the University of Utah, Florida State University, the University of Florida and currently Michigan State University. In 1980 he was instrumental in the establishment of the Western NARUC Rate Seminar and has annually served as an instructor since that time. This course is recognized as one of the best available for teaching rate-setting principles and methodology. More than 5,000 students have attended this course, including regulatory staff, utility personnel and members of accounting, engineering, legal and consulting firms throughout the country.

Mr. Guastella served as an instructor and panelist in a seminar on water and wastewater regulation conducted by the Independent Water and Sewer Companies of Texas. In 1998, he prepared and conducted a seminar on basic rate regulation on behalf of the New England Chapter of the National Association of Water Companies. In 2000 and 2001, Mr. Guastella developed and conducted a special seminar for developer related water and wastewater utilities in conjunction with Florida State University, and again in 2003 in conjunction with the University of Florida. It provided essential training for the financial structuring of small water and wastewater utilities, rate setting, financing and the establishment of their market value in the event of a negotiated sale or condemnation. In 2004, he prepared and conducted a special workshop seminar on behalf of the Office of Regulatory Staff of South Carolina, covering rate setting, valuation and general regulation of water and wastewater utilities. In 2006, he participated in an expert workshop on full cost pricing conducted by the U. S. Environmental Protection Agency in coordination with the Institute of Public Utilities, Michigan State University. In 2006, he prepared and conducted a special seminar on rate setting and valuation on behalf of the New York Chapter of the NAWC. In 2007, he prepared and conducted a special seminar on rate setting and valuation on behalf of the New England Chapter of NAWC.

Mr. Guastella has made presentations on a wide variety of rate, valuation and regulatory issues at meetings of the National Association of Regulatory Utility Commissioners, the American Water Works Association, the New England Water Works Association, the National Association of Water Companies, the New England Conference of Public Utilities Commissioners, the Florida, New England, New Jersey and New York Chapters of NAWC, the Mid-America Regulatory Conference, the Southeastern Association of Regulatory Utility Commissioners, the Pennsylvania Environmental Conference, and the Public Utility Law Section of the New Jersey Bar Association.

John F. Guastella
List of Proceedings in which Expert Testimony was Presented

Year	Client	State	Regulatory Docket/Case Number
1966	Sunhill Water Corporation	New York	23968
1967	Amagansett Water Company	New York	24210
1967	Worley Homes, Inc.	New York	24466
1968	Amagansett Water Company	New York	24718
1968	Amagansett Water Company	New York	24883
1968	Sunhill Water Corporation	New York	23968
1968	Worley Homes, Inc.	New York	Supreme Court
1969	Amagansett Water Supply	New York	24883
1969	Citizens Water Supply Co.	New York	25049
1969	Worley Homes, Inc.	New York	24466/24992
1970	Brooklyn Union Gas Company	New York	25448
1970	Consolidated Edison of New York	New York	25185
1971	Hudson Valley Water Companies	New York	26093
1971	Jamaica Water Supply Company	New York	26094
1971	Port Chester Water Works, Inc.	New York	25797
1971	U & I Corp. - Merrick District	New York	26143
1971	Wanakah Water Company	New York	25873
1972	Spring Valley Water Company	New York	26226
1972	U & I Corp. - Woodhaven District	New York	26232
1973	Citizens Water Supply Company	New York	26366
1978	Rhode Island DPU&C (Bristol County)	Rhode Island	1367A
1979	Candlewick Lake Utilities Co.	Illinois	76-0218
1979	Candlewick Lake Utilities Co.	Illinois	76-0347
1979	Candlewick Lake Utilities Co.	Illinois	78-0151
1979	Jacksonville Suburban Utilities	Florida	770316-WS
1979	New York Water Service Corporation	New York	27594
1979	Salem Hills Sewerage Disposal Corp. v. V. of Vorheesville	New York	Supreme Court
1979	Seabrook Water Corporation	New Jersey	7910-846
1979	Southern Utilities Corporation	Florida	770317-WS
1979	Township of South Brunswick	New Jersey	Municipal
1979	Westchester Joint Water Works	New York	Municipal
1979	Woodhaven Utilities Corporation	Illinois	77-0109
1980	Crestwood Village Sewer Company	New Jersey	BPU 802-78
1980	Crestwood Village Water Company	New Jersey	BPU 802-77
1980	Gateway Water Supply Corporation	Texas	Municipal
1980	GWW-Central Florida District	Florida	800004-WS
1980	Jamaica Water Supply Company	New York	27587
1980	Rhode Island DPU&C (Newport Water)	Rhode Island	1480
1981	Briarcliff Utilities, Inc.	Texas	3620
1981	Candlewick Lake Utilities Co.	Illinois	81-0011
1981	Caroline Water Company, Inc.	Virginia	810065
1981	GDU, Inc. - Northport	Florida	Municipal
1981	GDU, Inc. - Port Charlotte	Florida	Municipal
1981	GDU, Inc. - Port Malabar	Florida	80-2192
1981	Hobe Sound Water Company	Florida	8000776
1981	Lake Buckhorn Utilities, Inc.	Ohio	80-999
1981	Lake Kiowa Utilities, Inc.	Texas	3621
1981	Lakengren Utilities, Inc.	Ohio	80-1001
1981	Lorelei Utilities, Inc.	Ohio	80-1000
1981	New York Water Service Corporation	New York	28042
1981	Rhode Island DPU&C (Newport Water)	Rhode Island	1581
1981	Shawnee Hills Utility Company	Ohio	80-1002
1981	Smithville Water Company, Inc.	New Jersey	808-541
1981	Spring Valley Water Company, Inc.	New York	27936
1981	Spring Valley Water Company, Inc.	New York	27936
1981	Sunhill Water Corporation	New York	27903
1981	Swan Lake Water Corporation	New York	27904
1982	Chesterfield Commons Sewer Company	New Jersey	822-84
1982	Chesterfield Commons Water Company	New Jersey	822-83
1982	Crescent Waste Treatment Corp.	New York	Municipal
1982	Crestwood Village Sewer Company	New Jersey	821-33
1982	Crestwood Village Water Company	New Jersey	821-38
1982	Salem Hills Sewerage Disposal Corp.	New York	Municipal
1982	Township of South Brunswick	New Jersey	Municipal
1982	Woodhaven Utilities Corporation	Illinois	82-0167
1983	Country Knolls Water Works, Inc.	New York	28194
1983	Heritage Hills Water Works Corp.	New York	28453
1984	Crestwood Village Sewer Company	New Jersey	8310-861
1984	Crestwood Village Water Company	New Jersey	8310-860
1984	Environmental Disposal Corp.	New Jersey	816-552
1984	GDU, Inc. - Port St. Lucie	Florida	830421
1984	Heritage Village Water (water/sewer)	Connecticut	84-08-03
1984	Hurley Water Company, Inc.	New York	28820

John F. Guastella
List of Proceedings in which Expert Testimony was Presented

Year	Client	State	Regulatory Docket/Case Number
1984	New York Water Service Corporation	New York	28901
1985	Deltona Utilities (water/sewer)	Florida	830281
1985	J. Filiberto Sanitation, Inc.	New Jersey	8411-1213
1985	Sterling Forest Pollution Control	New York	Municipal
1985	Water Works Enterprise, Grand Forks	North Dakota	Municipal
1986	GDU, Inc. - Port Charlotte	Florida	Municipal
1986	GDU, Inc. - Sebastian Highlands	Florida	Municipal
1986	Kings Grant Water/Sewer Companies (settled)	New Jersey	WR8508-868
1986	Mt. Ebo Sewage Works, Inc.	New York	Municipal
1986	Sterling Forest Pollution Control	New York	Municipal
1987	Country Knolls Water Works, Inc.	New York	29443
1987	Crestwood Village Sewer Co. (settled)	New Jersey	WR8701-38
1987	Deltona Utilities - Marco Island	Florida	850151-WS
1987	Deltona Utilities, Inc. - Citrus Springs (settled)	Florida	870092-WS
1987	First Brewster Water Corp. v. Town of Southeast (settled)	New York	Supreme Court
1987	GDU, Inc. - Silver Springs Shores	Florida	870239-WS
1987	Ocean County Landfill Corporation	New Jersey	SR-8703117
1987	Palm Coast Utility Corporation	Florida	870166-WS
1987	Sanlando Utilities Corp. (settled)	Florida	860683-WS
1987	Township of South Brunswick	New Jersey	Municipal
1987	Woodhaven Utilities Corp. (settled)	Illinois	87-0047
1988	Crescent Estates Water Co., Inc.	New York	88-W-035
1988	Elizabethtown Water Co.	New Jersey	OAL PUC3464-88
1988	Heritage Village Water Company	Connecticut	87-10-02
1988	Instant Disposal Service, Inc.	New Jersey	SR-87080864
1988	J. Filiberto Sanitation v. Morris County Transfer Station	New Jersey	01487-88
1988	Ohio Water Service Co.	Ohio	86-1887-WW-CO1
1988	St. Augustine Shores Utilities	Florida	870980-WS
1989	Elizabethtown Water Co.	New Jersey	BPU WR89020132J
1989	GDU (FPSC generic proceeding as to rate setting procedures)	Florida	880883-WS
1989	Gordon's Corner Water Co.	New Jersey	OAL PUC479-89
1989	Heritage Hills Sewage Works	Connecticut	Municipal
1989	Heritage Village Water Company	Connecticut	87-10-02
1989	Palm Coast Utility Corporation	Florida	890277-WS
1989	Southbridge Water Supply Co.	Massachusetts	DPU 89-25
1989	Sterling Forest Water Co.	New York	PSC 88-W-263
1990	American Utilities, Inc. - United States Bankruptcy Court	New Jersey	85-00316
1990	City of Carson City	Nevada	Municipal
1990	Country Knolls Water Works, Inc.	New York	90-W-0458
1990	Elizabethtown Water Company	New Jersey	WR900050497J
1990	Kent County Water Authority	Rhode Island	1952
1990	Palm Coast Utility Corporation	Florida	871395-WS
1990	Southern States Utilities, Inc.	Florida	Workshop
1990	Trenton Water Works	New Jersey	WR90020077J
1990	Waste Management of New Jersey	New Jersey	SE 87070552
1990	Waste Management of New Jersey	New Jersey	SE 87070566
1991	City of Grand Forks	North Dakota	Municipal
1991	Gordon's Corner Water Co.	New Jersey	OAL PUC8329-90
1991	Southern States Utilities, Inc.	Florida	900329-WS
1992	Elizabethtown Water Co.	New Jersey	WR 91081293J
1992	General Development Utilities, Inc. - Port Malabar Division	Florida	911030-WS
1992	General Development Utilities, Inc. - West Coast Division	Florida	911067-WS
1992	Heritage Hills Water Works, Inc.	New York	92-2-0576
1993	General Development Utilities, Inc. - Port LaBelle Division	Florida	911737-WS
1993	General Development Utilities, Inc. - Silver Springs Shores	Florida	911733-WS
1993	General Waterworks of Pennsylvania - Dauphin Cons. Water Supply	Pennsylvania	R-00932604
1993	Kent County Water Authority	Rhode Island	2098
1993	Southern States Utilities - FPSC Rulemaking	Florida	911082-WS
1993	Southern States Utilities - Marco Island	Florida	920655-WS
1994	Capital City Water Company	Missouri	WR-94-297
1994	Capital City Water Company	Missouri	WR-94-297
1994	Elizabethtown Water Company	New Jersey	WR94080346
1994	Elizabethtown Water Company	New Jersey	WR94080346
1994	Environmental Disposal Corp.	New Jersey	WR94070319
1994	General Development Utilities - Port Charlotte	Florida	940000-WS
1994	General Waterworks of Pennsylvania	Pennsylvania	R-00943152
1994	Hoosier Water Company - Mooresville Division	Indiana	39839
1994	Hoosier Water Company - Warsaw Division	Indiana	39838
1994	Hoosier Water Company - Winchester Division	Indiana	39840
1994	West Lafayette Water Company	Indiana	39841
1994	Wilmington Suburban Water Corporation	Delaware	94-149 (stld)
1995	Butte Water Company	Montana	Cause 90-C-90
1995	Heritage Hills Sewage Works Corporation	New York	Municipal

John F. Guastella
List of Proceedings in which
Expert Testimony
was Presented

Year	Client	State	Regulatory Docket/Case Number
1996	Consumers Illinois Water Company	Illinois	95-0342
1996	Elizabethtown Water Company	New Jersey	WR95110557
1996	Palm Coast Utility Corporation	Florida	951056-WS
1996	PenPac, Inc.	New Jersey	OAL-00788-93N
1996	Southern States Utilities, Marco Island	Florida	950495-WS
1997	Crestwood Village Water Company	New Jersey	BPU 96100739
1997	Indiana American Water Co., Inc.	Indiana	IURC 40703
1997	Missouri-American Water Company	Missouri	WR-97-237
1997	South County Water Corp	New York	97-W-0667
1997	United Water Florida	Florida	960451-WS
1998	Consumer Illinois Water Company	Illinois	98-0632
1998	Consumers Illinois Water Company	Illinois	97-0351
1998	Heritage Hills Water Company	New York	97-W-1561
1998	Missouri-American Wastewater Company	Missouri	SR-97-238
1999	Consumers Illinois Water Company	Illinois	99-0288
1999	Environmental Disposal Corp.	New Jersey	WR99040249
1999	Indiana American Water Co., Inc.	Indiana	IURC 41320
2000	South Haven Sewer Works, Inc.	Indiana	Cause: 41410
2000	Utilities Inc. of Maryland	Maryland	CAL 97-17811
2001	Artesian Water Company	Delaware	00-649
2001	Citizens Utilities Company	Illinois	01-0001
2001	Elizabethtown Water Company	New Jersey	WR-0104205
2001	Kiawah Island Utility, Inc.	South Carolina	2001-164-W/S
2001	Placid Lakes Water Company	Florida	011621-WU
2001	South Haven Sewer Works, Inc.	Indiana	41903
2001	Southlake Utilities, Inc.	Florida	981609-WS
2002	Artesian Water Company	Delaware	02-109
2002	Consumers Illinois Water- Grant Park	Illinois	02-0480
2002	Consumers Illinois Water- Village Woods	Illinois	02-0539
2002	Valencia Water Company	California	02-05-013
2003	Consumers Illinois Water - Indianola	Illinois	03-0069
2003	Elizabethtown Water Company	New Jersey	WR-030-70510
2003	Golden Heart Utilities, Inc.	Alaska	U-02-13, 14 & 15
2003	Utilities, Inc. – Georgia	Georgia	CV02-0495-AB
2004	Aquarion Water Company	Connecticut	04-02-14
2004	Artesian Water Company	Delaware	04-42
2004	El Dorado Utilities, Inc.	New Mexico	D-101-CU-2004-
2004	Environmental Disposal Corp.	New Jersey	DPU WR 03 070509
2004	Heritage Hills Water Company	New York	03-W-1182
2004	Jersey City MUA	New Jersey	Municipal
2004	Rockland Electric Company	New Jersey	EF02110852
2005	Aquarion Water Company	New Hampshire	DW 05-119
2005	Intercoastal Utilities, Inc.	Florida	04-0007-0011-0001
2005	Haig Point Utility Company, Inc.	South Carolina	2005-34-W/S
2005	Aquarion Water Company	New Hampshire	DW 05-119
2005	South Central Connecticut Regional Water Auth.	Connecticut	Municipal
2006	Pennichuck Water Works, Inc.	New Hampshire	DW-04048
2006	Village of Williston Park	New York	Municipal
2006	Connecticut Water Company	Connecticut	06-07-08
2006	Birmingham Utilities, Inc.	Connecticut	06-05-10
2006	Aqua Utilities, Inc.	Florida	060368-WS
2007	Aquarion Water Company of CT	Connecticut	07-05-19
2007	Pennichuck Water Works, Inc.	New Hampshire	DW 04-048

Papers and Presentations
By
John F. Guastella

Year	Title	Forum
1974 through Present	1. Basics of Rate Setting 2. Cost Allocation and Rate Design 3. Revenue Requirements	Semi-annual seminars on utility rate regulation, National Association of Regulatory Utility Commissioners, sponsored by University of South Florida, of Utah, Florida State University, and University of Florida, held in the states of Florida, Utah and California
1974	Rate Design Studies: A Regulatory Point-of-View	Annual convention of the National Association of Water Companies, New Haven, Connecticut
1976	Lifeline Rates	Annual convention of the National Association of Water Companies, Chattanooga, Tennessee
1977	Regulating Water Utilities: The Customers' Best Interest	Annual symposium of the New England Conference of Public Utilities Commissioners, Mystic Seaport, Connecticut
1978	Rate Design: Preaching v. Practice	Annual convention of the National Association of Water Companies, Baton Rouge, Louisiana
1979	Small Water Companies	Annual symposium of the New England Conference of Public Utilities Commissioners, Newport, Rhode Island
1979	Rate Making Problems Peculiar to Private Water and Sewer Companies	Special educational program sponsored by Independent Water and Sewer Companies of Texas, Austin, Texas
1980	Water Utility Regulation	Annual meeting of the National Association of Regulatory Utility Commissioners,Houston, Texas
1981	The Impact of Water Rates on Water Usage	Annual Pennsylvania Environmental Conference, Harrisburg, Pennsylvania
1981	A Realistic Approach to Regulating Water Utilities	Mid-America Regulatory Conference, Clarksville, Indiana
1982	Issues in Water Utility Regulation	Annual symposium of the New England Conference of Public Utilities Commissioners, Rockport, Maine
1982	New Approaches to the Regulation of Water Utilities	Southeastern Association of Regulatory Utility Commissioners, Asheville, North Carolina
1983	Allocating Costs and Revenues Fairly and Effectively	Maryland Water and Sewer Finance Conference, Westminster, Maryland
1983	Lifeline and Social Policy Pricing	Annual conference of the American Water Works Association, Las Vegas, Nevada (published)
1984	The Real Cost of Service: Some Special Considerations	Annual New Jersey Section AWWA Spring Meeting, Atlantic City, New Jersey
1987	Margin Reserve: It's Not the Issue	Florida Waterworks Association Newsletter, April/May/June 1987 issue
1987	A "Current" Issue: CIAC	NAWC - New England Chapter November 6, 1987 meeting
1988	Small Water Company Rate Setting: Take It or Leave It	NAWC - New York Chapter June 14, 1988 meeting
1989	The Solution to all the Problems of Good Small Water Companies	NAWC Quarterly magazine, Winter issue
1989	Current Issues Workshop - Panel	New England Conference of Public Utilities Commissioners, Kennebunkport, Maine
1991	Alternative Rate Structures	New Jersey Section 1991 Annual Conference, AWWA, Atlantic City, New Jersey

Papers and Presentations
By
John F. Guastella

Year	Title	Forum
1994	Conservation Impact on Water Rates	New England NAWC and New England AWWA, Sturbridge, Massachusetts
1996	Utility Regulation - 21st Century	NAWC Annual Meeting, Orlando, Florida
1997	Current Status Drinking Water State Revolving Fund	NAWC Annual Meeting, San Diego, California
1998	Small Water Companies - Problems and Solutions	NAWC Annual Meeting, Indianapolis, Indiana
1998	Basic Rate Regulation Seminar	New England Chapter - NAWC, Rockport, Maine
2000	Developer Related Water and Sewer Utilities Seminar	Florida State University, Orlando, Florida
2001	Developer Related Water and Sewer Utilities Seminar	Florida State University, Orlando, Florida
2002	Regulatory Cooperation - Small Company Education	New England Chapter - NAWC, Annual Meeting
2003	Developer Related Water and Sewer Utilities Seminar	University of Florida, Orlando, Florida
2004	Basic Regulation & Rate Setting Training Seminar	Office of Regulatory Staff, Columbia, South Carolina
2005	Municipal Water Rates	Nassua-Suffolk Water Commissioners Association, Franklin Square, New York
2005	Innovations in Rate Setting and Procedures	NAWC New York Chapter, West Point, New York
2006	Basics of Rate Setting	The Connecticut Water Company, Clinton, Connecticut
2006	Innovations in Rate Setting and Procedures	NAWC New York Chapter, Catskill, New York
2006	Best Practices as Regulatory Policy	NAWC New England Chapter, Ogunquit, Maine
2006	Rate and Valuation Seminar	NAWC New York Chapter
2006	Full Cost Pricing	U.S. Environmental Protection Agency Expert Workshop, Lansing, Michigan
2006	Innovations in Rate Setting	NAWC New England Chapter, Portsmouth, New Hampshire
2007	Weather Sensitive Customer Demands	NAWC Water Utility Executive Council, Half Moon Bay, California
2007	Basics of Rate Setting and Valuation Seminar	NAWC New England Chapter, Ogunquit, Maine
2007	Small Company Charateristics	National Drinking Water Symposium, La Jolla, California

Docket No. 070183-WS
Exhibit JFG-1

GUIDE FOR DETERMINATION

OF

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OF NEEDED FIRE FLOW

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FOREWORD

ISO has prepared this guide as an aid in estimating the amount of water that should be available for municipal fire protection. ISO calls this the needed fire flow. This publication is only a guide and requires knowledge and experience in fire protection engineering for its effective application.

INDEX

PREFACE

ISO is the premier source of information, products, and services related to property and liability risk. For a broad spectrum of types of insurance, ISO provides statistical, actuarial, underwriting, and claims information and analyses; consulting and technical services; policy language; information about specific locations; fraud-identification tools; and data processing. In the United States and around the world, ISO serves insurers, reinsurers, agents, brokers, self-insureds, risk managers, insurance regulators, fire departments, and other government agencies.

One of ISO's important services is to evaluate the fire suppression delivery systems of jurisdictions around the country. The result of those reviews is a classification number that ISO distributes to insurers. Insurance companies use the Public Protection Classification (PPC™) information to help establish fair premiums for fire insurance – generally offering lower premiums in communities with better fire protection.

ISO uses the Fire Suppression Rating Schedule (FSRS) to define the criteria used in the evaluation of a community's fire defenses. Within the FSRS, a section titled "Needed Fire Flow" outlines the methodology for determining the amount of water necessary for providing fire protection at selected locations throughout the community. ISO uses the needed fire flows to:

1. Determine the community's "basic fire flow." The basic fire flow is the fifth highest needed fire flow in the community. ISO uses the basic fire flow to determine the number of apparatus, the size of apparatus fire pumps, and special fire-fighting equipment needed in the community.
2. Determine the adequacy of the water supply and delivery system. ISO calculates the needed fire flow for selected properties and then determines the water flow capabilities at these sites. ISO then calculates a ratio considering the need (needed fire flow) and the availability (water flow capability). ISO uses that ratio in calculating the credit points identified in the FSRS.

ISO developed the needed fire flow through a review of actual large-loss fires. ISO recorded the average fire flow and other important factors, including construction type, occupancy type, area of the building, and exposures. Those factors are the foundation of the needed fire flow formula.

The following pages include a number of excerpts from another ISO document, the Specific Commercial Property Evaluation Schedule (SCOPES). ISO uses the SCOPES manual to weigh features of individual properties for the purpose of defining the building's vulnerability to future fire loss. Insurers also use the information in their underwriting and ratemaking decisions.

CHAPTER 1

Needed Fire Flow Formula

To estimate the amount of water required to fight a fire in an individual, nonsprinklered building, ISO uses the formula:

$$NFF = (C)(O)(1+(X+P))$$

where

NFF	=	the needed fire flow in gallons per minute (gpm)
C	=	a factor related to the type of construction
O	=	a factor related to the type of occupancy
X	=	a factor related to the exposure buildings
P	=	a factor related to the communication between buildings

To calculate the needed fire flow of a building, you will need to determine the predominant type (class) of construction, size (effective area) of the building, predominant type (class) of occupancy, exposure to the property, and the factor for communication to another building.

Here is the step-by-step process:

Step 1. Determine the predominant construction type and the associated factor (F).
Step 2. Determine the effective area (A).
Step 3. Substituting the values for "F" and "A" into the formula $C=18F(A)^{0.5}$ and calculate the construction factor (C).
Step 4. Round the construction factor (C) to the nearest 250 gpm.
Step 5. Determine the predominant occupancy type and the associated factor (O).
Step 6. Determine if there is an exposure charge by identifying the construction type and length-height value of the exposure building as well as the distance (in feet) to the exposure building. Also make note of any openings and protection of those openings in the wall facing the subject building (the building the needed fire flow is being calculated on). The factor related to the exposure building is (X).
Step 7. Determine if there is a communication charge by identifying the combustibility of the passageway, whether the passageway is open or closed, the length, and a description of any protection provided in the passageway openings. The factor related to the communications between buildings is (P).
Step 8. Substitute the values for the factors in the formula $NFF = (C)(O)(1+(X+P))$ to determine the needed fire flow.

Note: ISO does not determine a needed fire flow for buildings rated and coded by ISO as protected by an automatic sprinkler system meeting applicable National Fire Protection Association standards. See Chapter 6, "Determining Recognition of Automatic Sprinkler Systems," for more information.

CHAPTER 2

Type of Construction (C) and Effective Area (A)

To determine the portion of the needed fire flow attributed to the construction and area of the selected building, ISO uses the formula:

$$C = 18F (A)^{0.5}$$

where

F = coefficient related to the class of construction
- F = 1.5 for Construction Class 1 (wood frame construction)
- = 1.0 for Construction Class 2 (joisted-masonry construction)
- = 0.8 for Construction Class 3 (noncombustible construction and Construction Class 4 (masonry noncombustible construction)
- = 0.6 for Construction Class 5 (modified fire-resistive construction) and Construction Class 6 (fire-resistive construction)

A = effective area

Appendix A provides C for a range of construction classes (F) and effective areas (A).

1. Construction Materials and Assemblies

ISO uses the following definitions to determine the construction class for a building:

a. Combustible: Wood or other materials that will ignite and burn when subjected to fire, including materials with a listed flame-spread rating greater than 25. Also included are assemblies or combinations of combustible materials with other materials, such as the following:

(1) Metal walls or floors sheathed on either interior or exterior surfaces (with or without air space) with wood or other combustible materials (flame-spread rating over 25).

(2) Metal floors or roofs with combustible insulation or other combustible ceiling material attached to the underside of the floor or interior surface of the roof deck, or within 18" of the horizontal supports.

(3) Combustible wall materials with an exterior surface of brick, stone, or other masonry materials (commonly known as "masonry veneer").

(4) Noncombustible wall or roof construction on a skeleton wood frame (commonly known as "wood-iron clad").

(5) Combustible wall or roof construction on a noncombustible or slow-burning frame.

(6) Composite assemblies of noncombustible materials with combustible materials, such as a combustible core between two noncombustible panels, or a noncombustible panel with a combustible insulation material (flame-spread rating over 25).

(7) Composite assemblies of noncombustible or slow-burning materials combined with foamed plastic materials (with any flame-spread rating), unless the foamed plastic materials qualify as slow-burning. (Refer to Item f, below.)

(8) Combustible assemblies which are listed as having not less than a one-hour rating.

b. **Fire-resistive:** Noncombustible materials or assemblies which have a fire-resistance rating of not less than one hour.

c. **Masonry:** Adobe, brick, cement, concrete, gypsum blocks, hollow concrete blocks, stone, tile, and similar materials with a minimum thickness of 4".

d. **Noncombustible:** Materials, no part of which will ignite and burn when subjected to fire, such as aluminum, asbestos board, glass, gypsum board, plaster, slate, steel, and similar materials. Also included are:

(1) Fire-resistive and protected-metal assemblies with a fire-resistance rating of less than one hour

(2) Materials or composite materials with a listed surface-flame-spread rating of 0 and of such composition that surfaces that would be exposed by cutting through the material in any way would not have a listed flame-spread rating greater than 0

(3) Masonry walls less than 4" thick, which are not a part of combustible walls (masonry veneer)

Note: Combustible nailing (furring) strips fastened directly to noncombustible supports shall not affect the classification of noncombustible walls, floors, or roofs.

e. **Protected metal:** Metal which is protected by materials so that the resulting assembly has a fire-resistance rating of not less than one hour.

f. **Slow-burning:** Materials with a listed flame-spread rating greater than 0 but not greater than 25; except, foamed plastic materials shall be rated as slow-burning if such materials or coverings meet one of the conditions in (1) or (2) below.

An acceptable thermal barrier includes those which have been tested as part of a field-fabricated or factory-manufactured composite assembly which has passed one of the acceptable wall or ceiling panel tests, when applied over foamed plastic material of a thickness and listed flame-spread rating not greater than that used in the composite assembly tested. Where any material is of a type which falls or drips to the floor of the furnace during the flame-spread test, the flame-spread rating of the material, when not protected by a thermal barrier, shall be based on the flame-spread rating of the material on the floor of the furnace, where this flame-spread is higher than the flame-spread of the material on the furnace ceiling. In all other cases, the normal flame-spread rating of the material on the furnace ceiling shall be used.

(1) An acceptable thermal barrier consisting of 1/2" or greater noncombustible material, such as plaster, cement, or gypsum board, when used over foamed plastic material having a listed flame-spread rating not greater than 25

(2) An acceptable thermal barrier which is listed with not less than a 15-minute finish rating when used over foamed plastic material having a listed flame-spread rating not greater than 25

Note 1: Combustible nailing (furring) strips fastened directly to slow-burning supports shall not affect the classification of slow-burning walls, floors, or roofs.

Note 2: Lumber and lumber products shall be eligible for consideration as slow-burning only when all the ceilings and the walls are treated with a listed flame-retardant impregnation which meets all of the following requirements:

(1) Impregnation-treated materials shall be properly identified as having a flame-spread rating of 25 or less.

(2) Such identification shall indicate that there is no evidence of significant progressive combustion when subjected to at least 30 minutes test duration.

(3) Such identification shall indicate that the material has a permanent treatment not subject to deterioration from the effects of weathering, exposure to moisture or humidity, etc. (This requirement only applies where the treated material is exposed to the weather or moisture.) However, combustible nailing (furring) strips, doors, trim, and the top surfaces of combustible floors shall not be required to be treated.

g. **Unprotected metal:** Metal with no fire-resistive protection, or with a fire-resistance rating of less than one hour.

2. Classification of Basic Construction Types

ISO classifies construction types into six different categories:

Construction Class 6 (fire-resistive construction)
Construction Class 5 (modified fire-resistive construction)
Construction Class 4 (masonry noncombustible construction)
Construction Class 3 (noncombustible construction)
Construction Class 2 (joisted-masonry construction)
Construction Class 1 (wood frame construction)

Note: In applying the rules below, ISO disregards below-grade basement walls and the construction of the lowest floor (usually concrete).

a. **Fire-resistive (Construction Class 6):** Buildings constructed of any combination of the following materials:

Exterior walls or exterior structural frame:

- Solid masonry, including reinforced concrete, not less than 4 inches in thickness

- Hollow masonry not less than 12 inches in thickness

- Hollow masonry less than 12 inches, but not less than 8 inches in thickness, with a listed fire-resistance rating of not less than two hours

- Assemblies with a fire-resistance rating of not less than two hours

Note: Panel or curtain sections of masonry may be of any thickness.

Floors and roof:

- Monolithic floors and roof of reinforced concrete with slabs not less than 4 inches in thickness

- Construction known as "joist systems" (or pan-type construction) with slabs supported by concrete joists spaced not more than 36 inches on centers with a slab thickness not less than 2 ¾ inches

- Floor and roof assemblies with a fire-resistance rating of not less than two hours

Structural metal supports:

- Horizontal and vertical load-bearing protected metal supports (including prestressed concrete units) with a fire-resistance rating of not less than two hours

Note: Wherever in the SCOPES reference is made to "prestressed," this term shall also include "posttensioned."

b. **Modified fire-resistive (Construction Class 5):** Buildings with exterior walls, floors, and roof constructed of masonry materials described in a., above, deficient in thickness, but not less than 4 inches; or fire-resistive materials described in a., above, with a fire-resistance rating of less than two hours, but not less than one hour.

c. **Masonry noncombustible (Construction Class 4):** Buildings with exterior walls of fire-resistive construction (not less than one hour), or of masonry, not less than 4 inches in thickness and with noncombustible or slow-burning floors and roof (including noncombustible or slow-burning roof decks on noncombustible or slow-burning supports, regardless of the type of insulation on the roof surface).

d. **Noncombustible (Construction Class 3):** Buildings with exterior walls, floors, and roof of noncombustible or slow-burning materials supported by noncombustible or slow-burning supports (including noncombustible or slow-burning roof decks on noncombustible or slow-burning supports, regardless of the type of insulation on the roof surface).

e. **Joisted-masonry (Construction Class 2):** Buildings with exterior walls of fire-resistive construction (not less than one hour), or of masonry, and with combustible floors and roof.

f. **Frame (Construction Class 1):** Buildings with exterior walls, floors, and roof of combustible construction, or buildings with exterior walls of noncombustible or slow-burning construction, with combustible floors and roof.

Notes applicable to construction-type definitions above:

Note 1: Masonry or fire-resistive walls with panels composed of glass, noncombustible, slow-burning, combustible, or open sections shall retain their classification as masonry or fire-resistive, provided that such panels are in or supported by a structural frame of masonry or protected metal (two hours fire resistance if in walls classed as Construction Class 6, one hour in classes 2, 4, or 5). Similarly, masonry or fire-resistive floors with wood or other combustible surfacing in buildings otherwise subject to Construction Classes 5 or 6 shall retain their classification as Classes 5 or 6.

Note 2: Noncombustible or slow-burning roof deck with an exterior surface of combustible materials, such as combustible insulation, felt, asphalt, or tar, shall retain its classification as noncombustible or slow-burning.

3. Crosswalk to Other Construction Types

The International Code Council (ICC) and the National Fire Protection Association (NFPA) have their own classification of construction types. These classifications are used in the codes and standards that they promulgate and are unique to their organization's publications. Below is a table that generally compares ISO's construction types to those of these other organizations.

Construction Types

ISO SCOPES Definition	ISO Construction Class	International Code (ICC)	NFPA 220	NFPA 5000	Standard Code 1997 (SBCCI)	National 1999 (BOCA)	Uniform Code 1997 (ICBO)
Wood frame	1	V, B	V	V	VI	5B	V
Ordinary (joisted masonry)	2	III, A	III	III	V	3	IIIV
Non-combustible (all metal)	3	II, B	II	II	IV	2C	11-N
Non-combustible (masonry)	4	II, A	II	III	IV	2B	II- 1 hr.
Modified – fire resistive	5	II, A	II	II	II	1B	II fire resistive
Fire resistive	6	I, A	I	I	I	1A	I
Heavy timber	2	IV	IV	IV	III	4	IV

4. Classification of Mixed Construction

In buildings constructed as defined in two or more classes above, ISO determines the appropriate construction class as follows:

Note: In applying these rules, ISO disregards basement walls and the lowest floor level.

a. **Fire-resistive:** Any building with 66 2/3 % or over of the total wall area and 66 2/3 % or over of the total floor and roof area constructed as defined in Construction Class 6.

b. **Modified fire-resistive:** Any building with 66 2/3 % or over of the total wall area and 66 2/3% or over of the total floor and roof area constructed as defined in Construction Class 5; or

Any building with 66 2/3% or over of the total wall area, and 66 2/3% or over of the total floor and roof area constructed as defined in Construction Classes 5 and 6, but with neither type in itself equaling 66 2/3% or over of the total area.

c. **Masonry noncombustible:** Any building with 66 2/3% or over of the total wall area and 66 2/3% or over of the total floor and roof area constructed as defined in Construction Class 4; or

Any building not qualifying under a. or b., above, with 66 2/3% or over of the total wall area and 66 2/3% or over of the total floor and roof area constructed as defined in two or more of Construction Classes 4, 5, and 6, but with no single type in itself equaling 66 2/3% or over of the total area.

d. **Noncombustible:** Any building with 66 2/3% or over of the total wall area and 66 2/3% or over of the total floor and roof area constructed as defined in Construction Class 3; or

Any building not qualifying under a. through c., above, with 66 2/3% or over of the total wall area and 66 2/3% or over of the total floor and roof area constructed as defined in two or more of Construction Classes 3, 4, 5, and 6, but with no single type in itself equaling 66 2/3% or over of the total area.

e. **Joisted-masonry:** Any building not qualifying under a. through d., above, with 66 2/3% or over of the total wall area constructed as described in Construction Class 2; or

Any building not qualifying under a. through d., above, with 66 2/3% or over of the total wall area and 66 2/3% or over of the total floor and roof area constructed as defined in two or more of Construction Classes 2, 3, 4, 5, and 6, but with no single type in itself equaling 66 2/3% or over of the total area.

f. **Frame:** Any building not qualifying under a. through e., above, or any building with over 33 1/3 % of the total wall area of combustible construction, regardless of the type of construction of the balance of the building.

5. Determining Effective Area (A_i)

In the portion of the needed fire flow formula attributed to the construction and area of the subject building,

$$C = 18F (A)^{0.5}$$

the factor "A" is the "effective area" of the subject building.

a. Exempt areas:

Disregard the following in the determination of the effective area:

- In nonsprinklered buildings, or buildings which do not qualify for sprinkler credit (see Chapter 6, "Determining Recognition of Automatic Sprinkler Systems"), disregard floor areas (including basement and subbasement) where the entire floor is protected by an acceptable system of automatic sprinklers or other acceptable automatic fire protection systems, provided that there are no Combustibility Class C-5 occupancies on the floor (see "Occupancy Factor," 1e., "Rapid-burning or flash-burning").

- Basement and subbasement areas which are vacant, or are used for building maintenance, or which are occupied by occupancies having C-1 or C-2 contents combustibility (see "Occupancy Factor") regardless of the combustibility class applicable to the building. A basement is a story of a building which is 50% or more below grade, unless such story is accessible at grade level on one or more sides. A story which is less than 50% below grade shall also be considered a basement if such story is wholly enclosed by blank masonry foundation walls.

- In breweries, malt mills, and other similar occupancies, disregard perforated (slatted) operating decks which contain no storage.

- Roof structures, sheds, or similar attachments.

- Courts without roofs.

- Areas of mezzanines less than 25% of the square foot area of the floor immediately below.

b. Modification for division walls:

An acceptable division wall shall be constructed entirely of noncombustible materials with a fire-resistance rating of not less than one hour, or of masonry materials, and shall:

(1) Extend from one exterior wall to another (or form an enclosed area within the building).

(2) Extend from one masonry or fire-resistive floor to another masonry or fire-resistive floor, or from a masonry or fire-resistive floor to a roof of any construction.

(3) Have all openings through the wall protected by an automatic or self-closing labeled Class B (not less than one-hour) fire door.

Where division walls meet the above requirements, the maximum area on any floor used to determine the effective area shall be the largest undivided area plus 50% of the second largest undivided area on that floor.

c. Effective-area calculation:

After modification for division walls as provided above, the effective area shall be the total square foot area of the largest floor in the building, plus the following percentage of the total area of the other floors:

(1) Buildings classified as Construction Classes 1 - 4: 50% of all other floors.

(2) Buildings classified as Construction Classes 5 or 6:

(a) If all vertical openings in the building are protected (see 4d., "Protection requirements," below), 25% of the area of not exceeding the two other largest floors.
(b) If one or more vertical openings in the building are unprotected (see 4d., "Protection requirements," below), 50% of the area of not exceeding 8 other floors with unprotected openings.

Note: The effective area determined under item 4c.(2)(b), above, shall not be less than the effective area that would be determined under item 4c.(2)(a), above, if all openings were protected.

d. Protection requirements:

The protection requirements for vertical openings are only applicable in buildings of Construction Class 5 or 6. The type of protection for vertical openings shall be based on the construction of the enclosure walls and the type of door or other device used for the protection of openings in the enclosure.

The following materials are acceptable for one-hour construction in enclosure walls: 4-inch brick, 4-inch reinforced concrete, 6-inch hollow block, 6-inch tile, or masonry or noncombustible materials listed with a fire-resistance rating of not less than one hour.

Protected openings:

Enclosures shall have walls of masonry or fire-resistive construction with a fire-resistance rating of not less than one hour.

Doors shall be automatic or self-closing and be labeled for Class B opening protection (not less than one-hour rating).

Elevator doors shall be of metal or metal-covered construction, so arranged that the doors must normally be closed for operation of the elevator.

Unprotected openings:

Unprotected floor openings. Also includes doors or enclosures not meeting the minimum requirements for protected openings, above.

5. Maximum and Minimum Value of C:

The value of C shall not exceed

8,000 gpm for Construction Class 1 and 2
6,000 gpm for Construction Class 3, 4, 5, and 6
6,000 gpm for a 1-story building of any class of construction

The value of C shall not be less than 500 gpm.

ISO rounds the calculated value of C to the nearest 250 gpm.

CHAPTER 3

Occupancy Factor (O)

The factors below reflect the influence of the occupancy in the subject building on the needed fire flow:

Occupancy Combustibility Class	Occupancy Factor (O)
C-1 (Noncombustible)	0.75
C-2 (Limited-combustible)	0.85
C-3 (Combustible)	1.00
C-4 (Free-burning)	1.15
C-5 (Rapid-burning)	1.25

1. Determining Occupancy Type

Occupancy combustibility classifications reflect the effect of the combustibility of contents on the building structure. ISO uses the following definitions to determine the combustibility classification of an occupancy:

a. **Noncombustible (C-1)** - Merchandise or materials, including furniture, stock, or equipment, which in permissible quantities do not in themselves constitute an active fuel for the spread of fire.

No occupancy shall be eligible to this classification which contains a sufficient concentration of combustible material to cause structural damage OR which contains a sufficient continuity of combustible materials so that a fire could spread beyond the vicinity of origin.

The maximum amount of combustible materials in any 10,000-square-foot section of an occupancy otherwise containing noncombustible materials shall not exceed 1000 board feet of lumber, or over 2 barrels (110 gallons) of combustible liquids or greases or equivalent amounts of other combustible materials. Further, the maximum total area containing combustible material in an occupancy otherwise containing noncombustible materials shall not exceed 5% of the total square foot area of that occupancy.

Note: In determining the applicability of C-1, combustible interior walls or partitions (including combustible finish), mezzanines, racks, shelves, bins, and similar combustible construction shall be considered combustible material.

Examples of occupancies which may (subject to survey) be eligible for C-1 classification include those storing asbestos, clay, glass, marble, stone, or metal products and some metalworking occupancies.

b. **Limited-combustible (C-2)** - Merchandise or materials, including furniture, stock, or equipment, of low combustibility, with limited concentrations of combustible materials.

Examples of occupancies classified as C-2 include banks, barber shops, beauty shops, clubs, habitational occupancies, hospitals, and offices.

Occupancies classified as C-2 in the occupancy classification list may be eligible for C-1 classification provided that such occupancy meets all of the requirements for C-1 classification.

Note: For manufacturing occupancies where over 20% of the total square foot area of the occupancy contains storage of combustible material or materials crated or wrapped in combustible containers, the combustibility class applicable to the occupancy shall not be less than C-3.

c. **Combustible (C-3)** - Merchandise or materials, including furniture, stock, or equipment, of moderate combustibility.

Examples of occupancies classified as C-3 include food markets, most wholesale and retail occupancies, etc.

Occupancies classified as C-3 in the occupancy classification list may be eligible for C-2 classification, provided that the total square foot area containing combustible material does not exceed 10% of the total square foot area of the occupancy.

Note: For the purpose of the above rule, combustible interior walls or partitions (including combustible finish), racks, shelves, bins, and similar combustible construction shall be considered combustible material.

d. **Free-burning (C-4)** - Merchandise or materials, including furniture, stock, or equipment, which burn freely, constituting an active fuel.

Examples of occupancies classified as C-4 include cotton bales, furniture stock, and wood products.

e. **Rapid-burning or flash-burning (C-5)** - Merchandise or materials, including furniture, stock, or equipment, which either

(1) burn with a great intensity

(2) spontaneously ignite and are difficult to extinguish

(3) give off flammable or explosive vapors at ordinary temperatures

(4) as a result of an industrial processing, produce large quantities of dust or other finely divided debris subject to flash fire or explosion

Examples of occupancies classified as C-5 include ammunition, excelsior, explosives, mattress manufacturing, matches, and upholsterers.

2. Determining Occupancy Combustibility Classification in Multiple Occupancy Buildings

In sole-occupancy buildings or in multiple-occupancy buildings with occupancies subject to a single-occupancy classification, the occupancy classification applicable to the occupant(s) shall also apply to the building.

In multiple-occupancy buildings with occupancies having different occupancy classifications, the occupancy classification applicable to the building shall be determined according to the total floor area (including basements and subbasements) occupied by each occupancy, as follows:

Note: Basement and subbasement areas which are either vacant or used for building services or building maintenance shall be considered C-2 combustibility. Where such areas are used for other purposes, the combustibility class for those areas shall be determined according to the combustibility class of their occupancies.

- **C-1** combustibility shall apply ONLY where 95% or more of the total floor area of the building is occupied by C-1 occupants, and there are no C-5 occupancies.

- **C-2** combustibility shall apply to buildings which
  a. do not qualify as C-1 above, but where 90% or more of the total floor area of the building is occupied by C-1 and C-2 occupancies; OR
  b. are classified as CSP Construction Class 5 or 6, AND where 80% or more of the total floor area of the building is occupied by C-1 and C-2 occupancies, AND NOT MORE THAN 5% of the total floor area is occupied by C-5 occupancies.

- **C-4** combustibility shall apply to any building containing C-4 occupants, where the combined total area occupied by C-4 and C-5 (if any) occupants is 25% OR MORE OF THE TOTAL FLOOR AREA of the building, provided the C-5 occupancies occupy, in total, less than 15% of the total floor area.

- **C-5** combustibility shall apply to any building where 15% OR MORE OF THE TOTAL FLOOR AREA is occupied by C-5 occupancies.

- **C-3** combustibility shall apply to any building not provided for above.

Occupancy Type Examples

Noncombustible (C-1) - Merchandise or materials, including furniture, stock, or equipment, which in permissible quantities do not in themselves constitute an active fuel for the spread of fire.

C-1 occupancy type examples:

- Asbestos storage
- Clay storage
- Marble storage
- Metal products storage
- Stone storage

Limited-combustible (C-2) - Merchandise or materials, including furniture, stock, or equipment, of low combustibility, with limited concentrations of combustible materials.

C-2 occupancy type examples:

- Airport, bus, railroad terminal
- Apartment
- Artist's studio
- Auto repair shop
- Auto showroom
- Aviary
- Barber shop
- Church
- Cold storage warehouse
- Day care center
- Educational institution
- Gasoline service station
- Greenhouse
- Health club
- Jail
- Library
- Medical laboratory
- Motel
- Museum
- Nursing home
- Office
- Pet grooming shop
- Photographer's studio
- Radio station
- Recreation center
- Rooming house
- Undertaking establishment

Combustible (C-3) - Merchandise or materials, including furniture, stock, or equipment, of moderate combustibility.

C-3 occupancy type examples:

- Auto parts store
- Auto repair training school
- Bakery
- Boat sales (where storage □ 15%)
- Book store
- Bowling establishment
- Casino
- Commercial laundry
- Contractor equipment storage
- Department store (where storage □ 15%)
- Dry cleaner (no flammable fluids)
- Gift shop (where storage □ 15%)
- Hardware store (where storage □ 15%)
- Leather processing
- Municipal storage building
- Nursery sales outlet store
- Pavilion or dance hall
- Pet shop
- Photographic supplies
- Printer
- Restaurant
- Sandwich shop
- Shoe repair
- Sporting goods (where storage □ 15%)
- Supermarket
- Theater
- Vacant building
- Wearing apparel factory (except furs)

Free-burning (C-4) - Merchandise or materials, including furniture, stock, or equipment, which burn freely, constituting an active fuel.

C-4 occupancy type examples:

- Aircraft hangers
- Cabinet making
- Combustible metals (e.g., Magnesium)
- Dry cleaner (using flammable fluids)
- Feed store (with > 1/3 ton of hay)
- Fur apparel manufacturing
- Furniture manufacturing
- Kennels
- Lumber
- Packaging and crating
- Paper products manufacturing
- Petroleum bulk-distribution center
- Stables
- Tire manufacturing
- Tire recapping or retreading
- Wax products (candles, etc.)
- Woodworking shop

Rapid-burning or flash-burning (C-5) - Merchandise or materials, including furniture, stock, or equipment, which either

(1) burn with a great intensity

(2) spontaneously ignite and are difficult to extinguish

(3) give off flammable or explosive vapors at ordinary temperatures

(4) as a result of an industrial processing, produce large quantities of dust or other finely divided debris subject to flash fire or explosion

C-5 occupancy type examples:

- Ammunition
- Feed mill (with > 7 tons of hay & straw)
- Fireworks
- Flammable compressed gases
- Flammable liquids
- Flour mill
- Highly flammable solids
- Matches
- Mattress factory
- Nitrocellulose-based plastics
- Painting with flammables or combustibles
- Rag storage
- Upholstering shop
- Waste paper storage

CHAPTER 4

Exposure and Communication Factor (X + P)

The factors developed in this item reflect the influence of adjoining and connected buildings on the needed fire flow. An exposure building has a wall 100 feet or less from a wall of the subject building. A communicating building has a passageway to the subject building. ISO develops a value for the exposure to another building for the side with the highest charge. Likewise, ISO develops a value for a communication to another building for the side with the highest charge. The formula is:

(X + P), with a maximum value of 0.60

1. Exposures (Table 330.A)

The factor for X depends upon the construction and length-height value (length of wall in feet, times height in stories) of the exposure building and the distance between facing walls of the subject building and the exposure building. Table 330.A of the FSRS gives the factors. When there is no exposure on a side, X = 0.

a. Construction of facing wall of exposure – ISO considers the wall construction of the exposure. The exposure factor used considers only the side of the subject building with the highest factor.
b. Length-height value of the facing wall of the exposure – ISO determines the length-height value of the facing wall of the exposure by multiplying the length of the facing wall of the exposure in feet by the height of the exposure in stories. ISO considers buildings five stories or more in height as five stories. Each 15 feet or fraction thereof equals one story.
c. Exposure distance – The distance in feet from the subject building to the exposure building, measured to the nearest foot, between the nearest points of the buildings. Where either the subject building or the exposure is at a diagonal to the other building, ISO increases the exposure distance by 10 feet.
d. Construction of facing wall of subject building – The wall construction of the subject building.

2. Exposure exceptions

The following conditions rule out exposure charges from adjacent buildings:

- Buildings rated sprinklered (See Chapter 6, "Determining Recognition of Automatic Sprinkler Systems.")
- Buildings rated as habitational, including their appurtenant outbuildings
- Buildings of Construction Class 5 or 6
- Buildings of Construction Class 3 or 4 with C-1 or C-2 contents combustibility class applicable to the building

TABLE 330.A FACTOR FOR EXPOSURE (X)						
			Construction of Facing Wall of Exposure Building Classes			
				2, 4, 5, & 6		
Construction of Facing Wall of Subject Building	**Distance in Feet to the Exposure Building**	**Length-Height of Facing Wall of Exposure Building**	**1,3**	**Unprotected Openings**	**Semiprotected Openings (wired glass or outside open sprinklers)**	**Blank Wall**
Frame, Metal or Masonry with Openings	0 – 10	1-100	0.22	0.21	0.16	0
		101-200	0.23	0.22	0.17	0
		201-300	0.24	0.23	0.18	0
		301-400	0.25	0.24	0.19	0
		Over 400	0.25	0.25	0.20	0
	11 - 30	1-100	0.17	0.15	0.11	0
		101-200	0.18	0.16	0.12	0
		201-300	0.19	0.18	0.14	0
		301-400	0.20	0.19	0.15	0
		Over 400	0.20	0.19	0.15	0
	31 - 60	1-100	0.12	0.10	0.07	0
		101-200	0.13	0.11	0.08	0
		201-300	0.14	0.13	0.10	0
		301-400	0.15	0.14	0.11	0
		Over 400	0.15	0.15	0.12	0
	61 - 100	1-100	0.08	0.06	0.04	0
		101-200	0.08	0.07	0.05	0
		201-300	0.09	0.08	0.06	0
		301-400	0.10	0.09	0.07	0
		Over 400	0.10	0.10	0.08	0
Blank Masonry Wall	Facing wall of the exposure building is higher than the subject building. Use the above table EXCEPT use only the length-height of the facing wall of the exposure building ABOVE the height of the facing wall of the subject building. Buildings five stories or over in height, consider as five stories.					
	When the height of the facing wall of the exposure building is the same or lower than the height of the facing wall of the subject building, X = 0.					

3. **Communications (Table 330.B)**

The factor for P depends upon the protection for communicating party-wall openings and the length and construction of communications between fire divisions. Table 330.B of the FSRS gives the factors. When more than one communication type exists in any one side wall, apply only the largest factor P for that side. When there is no communication on a side, P = 0.

a. Communications with combustible construction - An open passageway must be open on top or at least one side.
b. Fire-resistive, noncombustible, or slow-burning communications – ISO considers the type of construction found within the passageway.
c. Description of protection of passageway openings – The protection for the openings to the passageway by Class A or B, single or double fire door.

4. **Communications Exceptions**

The following conditions rule out charges for communication with other separately rated buildings:

- Buildings rated sprinklered (See Chapter 6, "Determining Recognition of Automatic Sprinkler Systems.")
- Buildings rated as habitational, including their appurtenant outbuildings
- Buildings of Construction Class 5 or 6
- Buildings of Construction Class 3 or 4 with C-1 or C-2 contents combustibility class applicable to the building

TABLE 330.B FACTOR FOR COMMUNICATIONS (P)

Description of Protection of Passageway Openings	Fire-resistive, Noncombustible, or Slow-Burning Communications				Communications with Combustible Construction					
	Open	Enclosed			Open			Enclosed		
	Any Length	10 Ft. or Less	11 Ft. to 20 Ft.	21 Ft. to 50 Ft. +	10 Ft. or Less	11 Ft. to 20 Ft.	21 Ft. to 50 Ft. +	10 Ft. or Less	11 Ft. to 20 Ft.	21 Ft. to 50 Ft. +
Unprotected	0	++	0.30	0.20	0.30	0.20	0.10	++	++	0.30
Single Class A Fire Door at One End of Passageway	0	0.20	0.10	0	0.20	0.15	0	0.30	0.20	0.10
Single Class B Fire Door at One End of Passageway	0	0.30	0.20	0.10	0.25	0.20	0.10	0.35	0.25	0.15
Single Class A Fire Door at Each End or Double Class A Fire Doors at One End of Passageway	0	0	0	0	0	0	0	0	0	0
Single Class B Fire Door at Each End or Double Class B Fire Doors at One End of Passageway	0	0.10	0.05	0	0	0	0	0.15	0.10	0

\+ For over 50 feet, P = 0.

++ For unprotected passageways of this length, consider the 2 buildings as a single fire division

Note: When a party wall has communicating openings protected by a single automatic or self-closing Class B fire door, it qualifies as a division wall for reduction of area. Where communications are protected by a recognized water curtain, the value of P is 0.

CHAPTER 5

Separate Classifications of Buildings

ISO classifies the following as separate buildings:

a. Buildings separated by two independent walls, with no common or continuous combustible roof, that meet all of the requirements under either (1), (2), or (3) below.

(1) Where there is no communication between the two buildings

(2) Where the independent walls have communicating passageways constructed and protected as follows:

(a) A passageway open on the top or at least one side

(b) An enclosed passageway of glass, noncombustible, slow-burning, or fire-resistive construction more than 10 feet in length (or, if combustible, more than 20 feet in length)

(c) An enclosed passageway of glass, noncombustible, slow-burning or fire-resistive construction 10 feet or less in length (or, if combustible, 20 feet or less in length), provided that any such passageway is protected on at least one end by an automatic or self-closing labeled Class A fire door installed in a masonry wall section in accordance with standards

Where one or both of the communicating buildings qualify for sprinkler credit under ISO's Specific Commercial Property Evaluation Schedule (see Chapter 6, "Determining Recognition for Automatic Sprinkler Systems"), the above rules (including the Class A door requirement) apply. However, where acceptable sprinklers are installed over the communication in a masonry wall in the sprinklered building, such sprinklers are acceptable in lieu of the Class A door.

NOTE: A passageway is a structure providing communication between two otherwise separate buildings. Passageways must not contain contents. Enclosed passageways must not be more than 15 feet in width (least dimension). Passageways open on the top or at least one side shall not be more than 25 feet in width (least dimension). Any communicating structure that contains contents, or is more than 15 feet in width if enclosed, or is more than 25 feet in width if open, is a structure subject to all of the requirements regarding separate classification under this item.

(3) Where the independent walls have no communications, or where the two buildings have passageways constructed and protected as provided above, ISO classifies each building separately, with appropriate charges for exposure and communication (if any) under Chapter 4, "Exposure and Communication Factor."

b. Buildings separated by one continuous masonry party wall conforming to all of the following requirements:

(1) The party wall is constructed of brick or reinforced concrete not less than 6 inches in thickness; OR reinforced concrete building units (or filled blocks) with a fire-resistance rating of not less than two hours and not less than 6 inches in thickness; OR other masonry materials not less than 8 inches in thickness.

(2) The party wall rises to the underside of AND is in direct contact with a fire-resistive, masonry, or noncombustible roof; OR pierces a slow-burning or combustible roof. In addition, no combustible material extends across any parapet that pierces a slow-burning or combustible roof.

(3) The party wall extends to the interior surface of AND is in direct contact with a fire-resistive, masonry, or noncombustible wall OR pierces a slow-burning or combustible wall. In addition, combustible cornices, canopies, or other combustible material do not extend across the party wall.

(4) All load-bearing structural metal members in the party wall are protected metal (not less than one hour).

(5) At least a single automatic or self-closing labeled Class A fire door protects all access communications through the party wall. Where one or both of the communicating buildings qualify for sprinkler credit under ISO's Specific Commercial Property Evaluation Schedule (see Chapter 6, "Determining Recognition for Automatic Sprinkler Systems"), acceptable sprinklers installed over the communications are acceptable in lieu of the Class A door.

A single, labeled 1½ hour damper protects all communications caused by air conditioning and/or heating ducts piercing a party wall.

Note 1: Where unprotected metal, noncombustible, or combustible wall, floor, or roof supports are continuous through a masonry wall, such a wall is not be acceptable for separate classification.

Note 2: ISO ignores the usual openings provided for common utilities when their size is limited to that necessary to provide for normal clearances and vibration; such openings are the rule rather than the exception, and their effect is included in the overall analysis. ISO also ignores openings protected by one-hour listed firestop systems. ISO may also ignore abnormally large openings when mortar or other masonry material fills the excessive clearances.

ISO classifies all buildings not eligible for separate classification under a. or b. as a single building.

CHAPTER 6

Determining Recognition of Automatic Sprinkler Systems

ISO uses the Specific Commercial Property Evaluation Schedule (SCOPES) to evaluate sprinkler protection of a property. The criteria within the SCOPES manual permit determination of the percentage of credit for the sprinkler protection. For ISO to rate and code the property as a sprinklered property, it must score at least 10 points (out of the initial 100 points available) in ISO's sprinkler grading.

A grading of 100 points represents the value of a two-source (water supply) wet-pipe installation, standard in all respects, where no unusual conditions of construction or occupancy exist. In addition, the system must be installed and maintained as outlined in the National Fire Protection Association (NFPA) Standard 13, NFPA Standard 25, and other NFPA standards as appropriate.

ISO classifies a property as a sprinklered property if it meets the following minimum conditions:

- The sprinklered building has assured maintenance. Shut down, idle, or vacant structures have acceptable watchman or waterflow and control-valve supervision (remote or central station) or a caretaker. A caretaker is a responsible person who visits the premises not less than weekly.
- The usable unsprinklered area does not exceed:
    a) 25% of the total area in buildings with an Occupancy Combustibility Class of C-1
    b) 20% of the total area in buildings with an Occupancy Combustibility Class of C-2 or C-3
    c) 10,000 square feet or 15% of the total area in buildings with an Occupancy Combustibility Class of C-4
    d) 5,000 square feet or 10% of the total square foot area in buildings with an Occupancy Combustibility Class of C-5

    See Chapter 3, "Occupancy Factor" for definitions of the occupancy combustibility classes.

    Note: the area limitations above do not include unused, unsprinklered areas such as underfloor areas, attic areas, etc. However, ISO classifies usable vacant areas as used areas. ISO considers areas with obstructed sprinklered protection as unsprinklered.
- Installation has evidence of flushing and hydrostatic tests of both the underground and overhead piping in accordance with NFPA Standard 13.
- A full-flow main drain test has been witnessed within the last 48 months.
- Dry-pipe installations have evidence of a satisfactory or partly satisfactory dry-pipe trip test conducted within the last 48 months.
- Fire-pump installations have evidence and results of a fire-pump test conducted within the last 48 months.

CHAPTER 7

Other Considerations for Determining Needed Fire Flow (NFF)

- When the subject building or exposure buildings have a wood-shingle roof covering and ISO determines that the roof can contribute to spreading fires, ISO adds 500 gpm to the needed fire flow.

- The maximum needed fire flow is 12,000 gpm. The minimum is 500 gpm.

- ISO rounds the final calculation of needed fire flow to the nearest 250 gpm if less than 2,500 gpm and to the nearest 500 gpm if greater than 2,500 gpm.

- For 1- and 2-family dwellings not exceeding 2 stories in height, ISO uses the following needed fire flows:

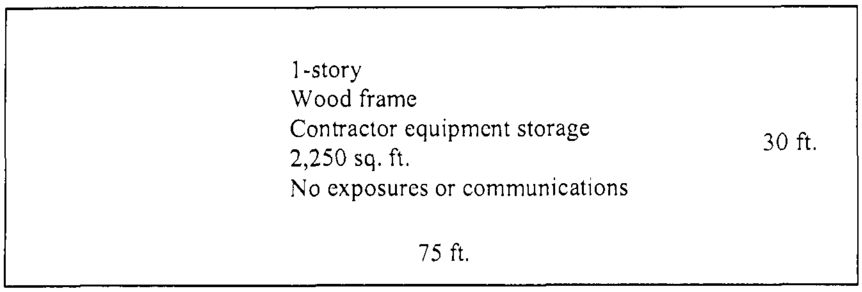
DISTANCE BETWEEN BUILDINGS	NEEDED FIRE FLOW
More than 100'	500 gpm
31-100'	750 gpm
11-30'	1,000 gpm
10' or less	1,500 gpm

- For other types of habitational buildings, the maximum needed fire flow is 3,500 gpm.

CHAPTER 8

Examples

Example 1.



CONSTRUCTION TYPE

Construction Class 1 (wood frame construction)
Construction type coefficient (F) = 1.5
Effective area (A) = 2,250

$C = 18F\,(A)^{0.5}$
$C = 18(1.5)\,(2{,}250)^{0.5}$
$C = 27\,(47.43)$
$C = 1{,}280.72$
C = 1,250 (rounded to the nearest 250 gpm)

OCCUPANCY TYPE

Contractor equipment storage
Occupancy combustibility class C-3 (Combustible)
Occupancy factor (O) = 1.00

EXPOSURES AND COMMUNICATIONS

None
Exposure and communication factor (X + P) = 0.00

CALCULATION

NFF = (C)(O)(1+(X+P))
NFF = (1,250)(1.00)(1+(0.00))
NFF = (1,250)(1.00)(1.00)
NFF = 1,250 gpm

Example 2

2-story
Masonry walls, wood-joisted roof and floors
Concrete on Grade
Furniture manufacturing
Ground floor = 14,000 sq. ft. 80 ft.
No exposures or communications

175 ft.

CONSTRUCTION TYPE

Construction Class 2 (joisted-masonry construction)
Construction type coefficient (F) = 1.0
Effective area (A) = 21,000 (ground floor + ½ of second floor area)

$C = 18F\,(A)^{0.5}$
$C = 18(1.0)\,(21{,}000)^{0.5}$
$C = 18\,(144.91)$
$C = 2{,}608.45$
C = 2,500 (rounded to the nearest 250 gpm)

OCCUPANCY TYPE

Furniture manufacturing
Occupancy combustibility class C-4 (free-burning)
Occupancy factor (O) = 1.15

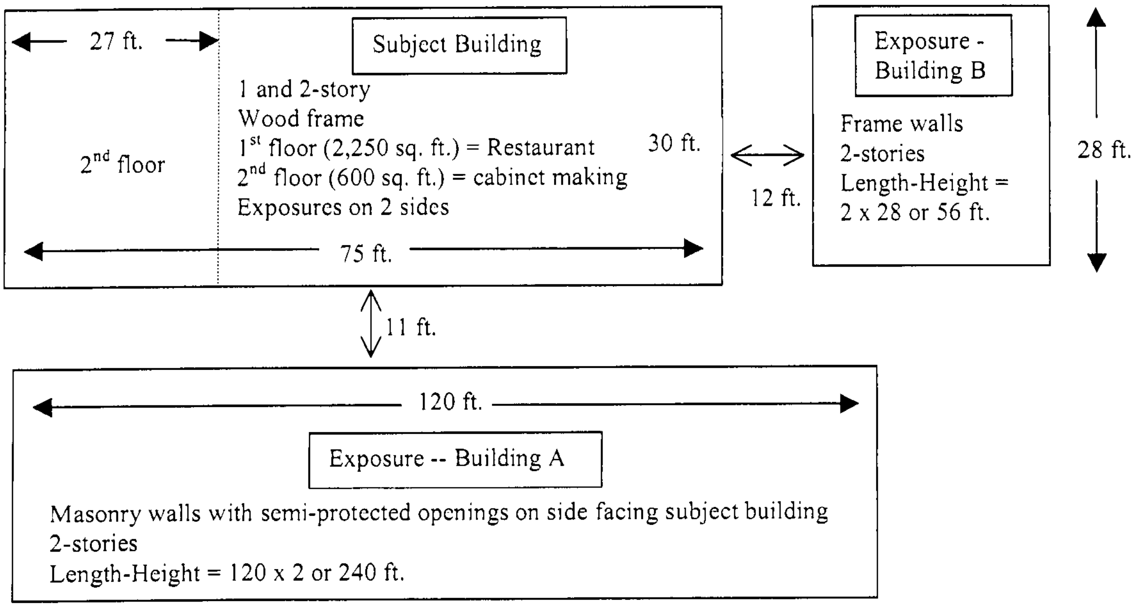
EXPOSURES AND COMMUNICATIONS

None
Exposure and communication factor (X + P) = 0.00

CALCULATION

NFF = (C)(O)(1+(X+P))
NFF = (2,500)(1.15)(1+(0.00))
NFF = (2,500)(1.15)(1.00)
NFF = 2,875
NFF = 3,000 gpm (because it is greater than 2,500 ISO rounds the NFF to the nearest 500 gpm)

Example 3



CONSTRUCTION TYPE

Construction Class 1 (wood-frame construction)
Construction type coefficient (F) = 1.5
Effective area (A) = 2,655 (ground floor + ½ of second floor area)

$C = 18F (A)^{0.5}$
$C = 18(1.5) (2,655)^{0.5}$
$C = 27(51.53)$
$C = 1,391.31$
C = 1,500 (rounded to the nearest 250 gpm)

OCCUPANCY TYPE

Cabinet making (occupies over 25% of the total floor of the building)
Occupancy combustibility class C-4 (free-burning)
Occupancy factor (O) = 1.15

EXPOSURES AND COMMUNICATIONS

Exposure charge for Building A = 0.14
Exposure charge for Building B = 0.17
The building with the highest charge is Building B.
Exposure factor (X) = 0.17
Communication (P) charge = none
Exposure and communication factor (X + P) = 0.17

CALCULATION

NFF = (C)(O)(1+(X+P))
NFF = (1,500)(1.15)(1+(0.17))
NFF = (1,500)(1.15)(1.17)
NFF = 2,018
NFF = 2,000 gpm

APPENDIX A

Needed Fire Flow/Effective Area Table

TYPE OF CONSTRUCTION FACTOR AS DETERMINED BY RANGE IN EFFECTIVE AREA

Class	1		2		3,4		5,6	
Factor (F)	1.5		1.0		0.8		0.6	
	Effective Area (A)		Effective Area (A)		Effective Area (A)		Effective Area (A)	
(C)	At Least	Not Over	At Least	Not Over	At Least	Not Over	At Least	Not Over
500	0	535	0	1,205	0	1,883	0	3,348
750	536	1,050	1,206	2,363	1,884	3,692	3,349	6,564
1,000	1,051	1,736	2,364	3,906	3,693	6,103	6,565	10,850
1,250	1,737	2,593	3,907	5,835	6,104	9,117	10,851	16,209
1,500	2,594	3,622	5,836	8,150	9,118	12,734	16,210	22,639
1,750	3,623	4,822	8,151	10,852	12,735	16,954	22,640	30,140
2,000	4,823	6,194	10,853	13,937	16,955	21,776	30,141	38,714
2,250	6,195	7,737	13,938	17,409	21,777	27,202	38,715	48,359
2,500	7,738	9,452	17,410	21,267	27,203	33,230	48,360	59,076
2,750	9,453	11,338	21,268	25,511	33,231	39,861	59,077	70,864
3,000	11,339	13,395	25,512	30,140	39,862	47,095	70,865	83,724
3,250	13,396	15,624	30,141	35,156	47,096	54,931	83,725	97,656
3,500	15,625	18,025	35,157	40,557	54,932	63,374	97,657	112,659
3,750	18,026	20,597	40,558	46,344	63,375	72,413	112,660	128,734
4,000	20,598	23,341	46,345	52,517	72,414	82,058	128,735	145,881
4,250	23,342	26,256	52,518	59,076	82,059	92,306	145,882	164,100
4,500	26,257	29,342	59,077	66,020	92,307	103,156	164,101	183,390
4,750	29,343	32,600	66,021	73,350	103,157	114,610	183,391	203,751
5,000	32,601	36,029	73,351	81,066	114,611	126,666	203,752	225,185
5,250	36,030	39,630	81,067	89,168	126,667	139,325	225,186	247,690
5,500	39,631	43,402	89,169	97,656	139,326	152,587	247,691	271,267
5,750	43,403	47,346	97,657	106,529	152,588	166,452	271,268	295,915
6,000	47,347	51,461	106,530	115,788	166,453		295,916	
6,250	51,462	55,748	115,789	125,434				
6,500	55,749	60,206	125,435	135,464				
6,750	60,207	64,836	135,465	145,881				
7,000	64,837	69,637	145,882	156,684				
7,250	69,638	74,609	156,685	167,872				
7,500	74,610	79,753	167,873	179,446				
7,750	79,754	85,069	179,447	191,406				
8,000	85,070		191,407					

Docket No. 070183-WS
Exhibit JFG-2

STANDARD SCHEDULE

FOR GRADING CITIES AND TOWNS OF THE

UNITED STATES

WITH REFERENCE TO THEIR FIRE DEFENSE

AND PHYSICAL CONDITIONS

STANDARD SCHEDULE

FOR

GRADING

CITIES AND TOWNS OF THE UNITED STATES

WITH REFERENCE

TO THEIR FIRE DEFENSES AND PHYSICAL CONDITIONS

NATIONAL BOARD OF FIRE UNDERWRITERS

New York, Chicago, San Francisco

Adopted, December 14, 1916

Edition of 1956

For residential districts only, the required duration may be reduced for required fire flows of 2,500 gpm and less, but in no case shall it be less than 50 per cent of that given in Table 6 for the corresponding required fire flow, and the minimum duration required in any case shall be 2 hours.

TABLE 5.

REQUIRED FIRE FLOW

Population	*Required Fire Flow for Average City, gpm*	*mgd*	*Duration, hours*	*Population*	*Required Fire Flow for Average City, gpm*	*mgd*	*Duration, hours*
1,000	1,000	1.44	4	22,000	4,500	6.48	10
1,500	1,250	1.80	5	27,000	5,000	7.20	10
2,000	1,500	2.16	6	33,000	5,500	7.92	10
3,000	1,750	2.52	7	40,000	6,000	8.64	10
4,000	2,000	2.88	8	55,000	7,000	10.08	10
5,000	2,250	3.24	9	75,000	8,000	11.52	10
6,000	2,500	3.60	10	95,000	9,000	12.96	10
10,000	3,000	4.32	10	120,000	10,000	14.40	10
13,000	3,500	5.04	10	150,000	11,000	15.84	10
17,000	4,000	5.76	10	200,000	12,000	17.28	10

Over 200,000 population, 12,000 gpm, with 2,000 to 8,000 gpm additional for a second fire, for a 10-hour duration.

Pressure. In grading a water supply the principal requirement considered is the ability to deliver water in sufficient quantity to permit pumpers of the Fire Department to obtain an adequate supply from hydrants. To overcome friction loss in the hydrant branch, hydrant, and suction hose, a minimum residual water pressure of 20 psi is required during flow, except that a minimum of 10 psi is permissible in districts where there is no deficiency in Items 28 or 29 and no deficiency for size of hydrants or hydrant connections in Item 31, where all hydrants are provided with at least one nominal $4\frac{1}{2}$-inch outlet, and where the large outlet is normally used by the Fire Department.

Higher sustained pressure is of value in permitting direct supply to automatic sprinkler systems and building standpipe-and-hose systems, and in maintaining a water plane such that no portion of the protected area is without water. Such pressure may also be of value in enabling the Fire Department to use satisfactory hose streams direct from hydrants.

For communities requiring not more than 2,500 gpm fire flow and with not more than 10 buildings exceeding 3 stories in height, a residual pressure of 60 psi, and for other places a residual pressure of not less than 75 psi, maintained under fire demand, will permit the Fire Department to use effective streams direct from hydrants if hydrant spacing is such as to allow short hose lines; in thinly built residential sections and in small village mercantile districts having buildings of small area and not exceeding 2 stories, a residual pressure of 50 psi may be satisfactory.

The value of higher pressures is recognized in Items 6c, 20, 21, 22, and 23, Water Supply, Items 13 and 14, Fire Department, and Item 2, Credits.

1. APPOINTMENT OF EMPLOYEES

Employees of municipal systems shall be under adequate civil service rules or the equivalent, properly administered, with tenure of office secure. Long tenure of office and an efficient organization may be considered the equivalent.

For inadequate provisions for appointment and tenure:
Use 1/10 Deficiency Scale.

2. QUALIFICATIONS OF EXECUTIVES

The superintendent or chief engineer and his assistants shall be qualified by experience, preferably supplemented by education and professional registration, to perform their respective duties efficiently.

For executives not qualified:
Use 1/10 Deficiency Scale.

GRADING SCHEDULE

WATER SUPPLY

An adequate and reliable water supply is an essential part of the fire-fighting facilities of a municipality.

Minimum Recognized Water Supply. In order to be recognized for grading purposes, a water supply shall be capable of delivering at least 250 gpm for a period of 2 hours, or 500 gpm for one hour, for fire protection plus consumption at the maximum daily rate. Any water supply which cannot meet this minimum requirement shall not be graded, and a deficiency of 1,950 points shall be assigned.

Adequacy and Reliability. A water supply is considered to be adequate if it can deliver the required fire flow for the number of hours specified in Table 4, with consumption at the maximum daily rate; if this delivery is possible under certain emergency or unusual conditions, the water supply is also considered to be reliable.

TABLE 4.

REQUIRED DURATION FOR FIRE FLOW

Required Fire Flow gpm	Required Duration Hours
10,000 and greater	10
9,500	9
9,000	9
8,500	8
8,000	8
7,500	7
7,000	7
6,500	6
6,000	6
5,500	5
5,000	5
4,500	4
4,000	4
3,500	3
3,000	3
2,500 and less	2

In order to provide reliability, duplication of some or all parts of a water supply system will be necessary, the need for duplication being dependent upon the extent to which the various parts may reasonably be expected to be out of service as a result of maintenance and repair work, an emergency, or some unusual condition. The introduction of storage, either as part of the supply works or on the distribution system, may partially or completely offset the need for duplicating various parts of the system; the value of the storage depends upon its amount, location, and availability.

Docket No. 070183-WS
Exhibit JFG-3

WATER RATES

AWWA MANUAL M1

4^{TH} EDITION

Water Rates

AWWA MANUAL M1

Fourth Edition

FOUNDED 1881

American Water Works Association

customer class that places summertime lawn irrigation loads on the system typically has a much higher peak-demand requirement, relative to the average demand, than does a petroleum refinery, which may require water on a relatively uniform basis throughout the year.

The classification of water customers as to whether they are inside or outside the city limits is related to each major group's responsibility for overall costs. As explained later in this manual, this factor is of major importance to government-owned utilities and may, in some instances, have a bearing on investor-owned utilities.

Legal requirements or customs may require recognition of certain customer classifications from an accounting standpoint, and such requirements can be accommodated in rate studies. However, general service characteristics, demand patterns, and location with regard to city limits are generally the principal considerations in customer classification.

General Classes

The three principal customer classes typical of most water utilities are (1) residential, (2) commercial, and (3) industrial. Definition of these general customer classes differs among utilities, but in very broad terms, the following definitions are common:

Residential—One- and two-family dwellings, usually physically separate.

Commercial—Multifamily apartment buildings and nonresidential, nonindustrial business enterprises.

Industrial—Manufacturing and processing establishments.

For specific utilities, there may be a breakdown of these general classes into more specific groups. For example, the industrial customer group may be subdivided into small industry, large industry, and special, the latter typified by a petroleum refinery.

In many systems, particularly larger ones, frequently there are customers having individual water-use characteristics, service requirements, or other reasons that set them apart from other customers with regard to cost responsibility. These customers should, therefore, have a separate class designation. Such classes may include large hospitals, universities, military establishments, and other such categories.

Special Classes

In addition to the general classes of service previously described, water utilities often provide service to certain special classes of customers. Four of those considered here are (1) wholesale service, (2) fire-protection service, (3) lawn irrigation, and (4) air conditioning and refrigeration.

Wholesale service. Wholesale service is usually defined as a situation in which water is sold to a customer at one or more major points of delivery for resale to individual retail customers within the wholesale customer's service area. Treated-water service is provided in most cases, but on occasion raw water is provided to wholesale customers. Usually, the wholesale customer is a separate municipality or water district adjacent to the supplying utility, but it may be in an area within the jurisdiction of the supplying utility.

Fire-protection service. Fire-protection service has characteristics that are markedly different from other types of water service. The service provided is principally of a standby nature—that is, readiness to deliver relatively large quantities of water for short periods of time at any of a large number of points in the water distribution system while the total annual quantity of water delivered is relatively small.

There are two principal approaches to the determination of fire-protection service costs that differ widely in both theory and application. One approach proposes that the costs of fire-protection service, other than those of the direct cost related to the hydrants themselves, be determined on the basis of the potential demand for water for fire-fighting purposes in relationship to the total of all potential demands for water. A second approach proposes that fire-protection-service costs be allocated as an incremental cost to the costs of general water service. This second approach is based on the premise that the prime function of the water utility is to supply general water service and that fire-protection service is a supplementary service. Each approach has advocates among water utility professionals. For the purposes of illustration in this manual, the first approach discussed above is used.

Costs allocated to fire-protection service as a class can be subdivided into those related to public fire-protection service and private fire-protection service. The specific methodology for such subdivision is presented in chapter 4.

The reader of this manual is referred to chapter 2 of AWWA Manual M26, *Water Rates and Related Charges*, for further discussion of fire-protection rates and charges.

Lawn irrigation. Residential lawn irrigation is characterized by the relatively high demands it places on the water system, usually during the late afternoon and early evening hours. In most of the United States, lawn irrigation is very seasonal in nature, being most pronounced during the summer months and virtually nonexistent during the winter months.

In most instances, lawn irrigation service is not separate from other service; therefore, the high-peaking characteristics of lawn irrigation need to be recognized as a part of residential-class water-use characteristics. However, where separate metering for lawn irrigation is provided, as is sometimes the case for automatic lawn sprinkling systems, parks, and golf courses, and where such loads are significant in the system, a separate class designation is warranted.

Air conditioning and refrigeration. In the 1950s and 1960s, there was a trend away from water-cooled air conditioning and refrigeration. Subsequent to the rapid increase in electric-power and natural-gas costs in the 1970s, commercial and industrial customers have reconsidered the economics of alternative cooling methods. In some cases, it has been found that higher initial outlays for water-cooled units can be more than offset by the operating economies of water costs versus power requirements. In many communities, however, city codes prohibit the use of "water-wasting" units. The use of recirculating units needing only make-up water is a proposed alternative. Make-up water requirements will vary, but a common rule of thumb for make-up water due to evaporation, quality control, and other causes is estimated as 20 gpd/ton of air conditioning.

A survey of the magnitude of water-cooled air conditioning and refrigeration service provided or expected could determine the need or advisability of recognition of such service as a separate class.

Service Outside City Limits

Many government-owned utilities recognize in their rate structures the differences in costs of serving water users located outside the corporate limits of the supplying city or jurisdiction compared with those located within the corporate limits. A government-owned utility may be considered to be the property of the citizens within the city. Customers within the city are owner customers, who must bear the risks and

Costs related to billing and collecting may be distributed among customer classes based on the total number of bills rendered to the respective classes in a test year. In some instances, it is appropriate to recognize, through billing ratios, that billing and collecting for larger services may incur more cost than for smaller services.

An illustration of the development of the test-year units of service for the hypothetical utility, using the base–extra capacity method of cost allocation and distribution, is presented in Table 3-1. Test-year units of service reflect the prospective average annual customer water-use requirements during the test-year study period considered in this example.

For the example, it is assumed that retail service and fire-protection service are provided inside the city to residential, commercial, and industrial classes. Outside-city service is provided on a wholesale basis.

For each customer class, under the heading of Base in Table 3-1, the total annual water use in thousand gallons is shown, as well as the average rate in thousand gallons per day. Maximum-day capacity factors are applied to average-day rates of flow to develop total capacity by class. Extra capacity is the difference between total capacity and average rate of use. Fire-protection service is considered to require negligible flow on an average basis but 960 thou. gpd on a maximum daily basis. Maximum-hour extra capacity is developed similarly. Maximum-hour fire-protection service reflects the assumption that flow for fires is concentrated in a four-hour period.

Equivalent meters and services are derived by applying equivalent ratios to the number of meters of each size by class. The number of bills is simply the total number of bills rendered annually for each class.

Table 3-2 shows the development of the units of service applicable to the commodity–demand method of cost allocation. It differs from Table 3-1 only by the fact that the maximum-day extra capacity column is excluded.

It should be recognized that the maximum total capacity on both a maximum-day and maximum-hour basis for the total system (shown in Tables 3-1 and 3-2) is the estimate of the sum of noncoincidental peaking requirements on the system; that is, it is the sum of the peaks for each class, regardless of the day or hour in which such

Table 3-1 Units of Service—Base–Extra Capacity Method (Test Year)

	Base		Maximum Day			Maximum Hour				
Customer Class	Annual Use *thou. gal*	Average Rate *thou. gpd*	Capacity Factor %	Total Capacity *thou. gpd*	Extra Capacity *thou. gpd*	Capacity Factor %	Total Capacity *thou. gpd*	Extra Capacity* *thou. gpd*	Equivalent Meters and Services	Bills
Inside-City										
Retail service										
Residential	968,000	2,652	250	6,630	3,978	400	10,608	3,978	15,652	185,760
Commercial	473,000	1,296	200	2,592	1,296	325	4,212	1,620	1,758	14,640
Industrial	1,095,000	3,000	150	4,500	1,500	200	6,000	1,500	251	420
Fire-protection service				960	960		5,760	4,800		
Total inside-city	2,536,000	6,948		14,682	7,734		26,580	11,898	17,661	200,820
Outside-City										
Wholesale service	230,000	630	225	1,418	788	375	2,363	945	34	48
Total system	2,766,000	7,578		16,100	8,522		28,943	12,843	17,695	200,868

*Maximum-hour demand in excess of maximum-day demand