



POLICY ISSUE

(Notation Vote)

SECY-87-186A

October 5, 1987

For: The Commissioners

From: Victor Stello, Jr.
Executive Director for Operations

Subject: DISTRIBUTION OF RADIOACTIVE GEMS IRRADIATED IN REACTORS
TO UNLICENSED PERSONS (FOLLOW-UP TO SECY-87-186)

Purpose: To answer the Commission's questions raised in response to
SECY-87-186, and to request Commission approval of staff
recommendations regarding the radioactive gemstone issue.

Category: This paper covers a minor policy issue regarding application and
enforcement of NRC regulations. However, it relates to two major
policy issues: de minimis quantities of radioactive material and
regulation of radioactive consumer products.

Issue: What regulatory position should NRC take with respect to
radioactive gemstones?

Background: In SECY-87-186, dated July 28, 1987, the staff informed the
Commission of its plans to stop distribution of neutron-
irradiated gems in the U.S. from both U.S. and foreign reactors.
[REDACTED] the Staff
Requirements Memorandum dated August 25, 1987 requested a more
comprehensive paper. This paper provides a more comprehensive
analysis of the gemstone issue. Additional discussion of
specific questions and concerns raised by the Commissioners is
provided in Enclosure 1. Additional information recently
received from the American Gem Trade Association on the gemstone
industry is provided in Enclosure 2.

The radioactive gemstone issue was not raised internally by the
staff. It was raised by reactor licensees and others. Some were
interested in entering the business; others questioned whether
NRC had authorized distribution of radioactive gemstones. On the
surface, the issue appears to be trivial, but it has escalated
into a significant regulatory dilemma. The issue relates to

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8804150339 880408
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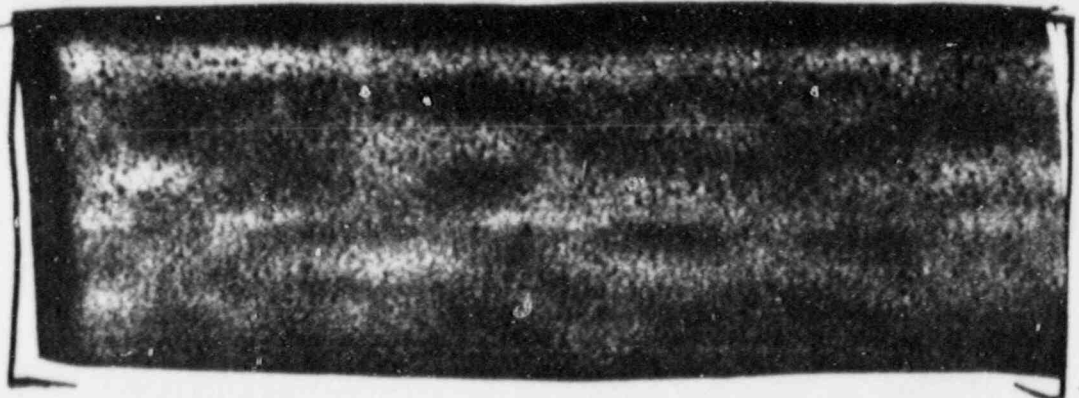
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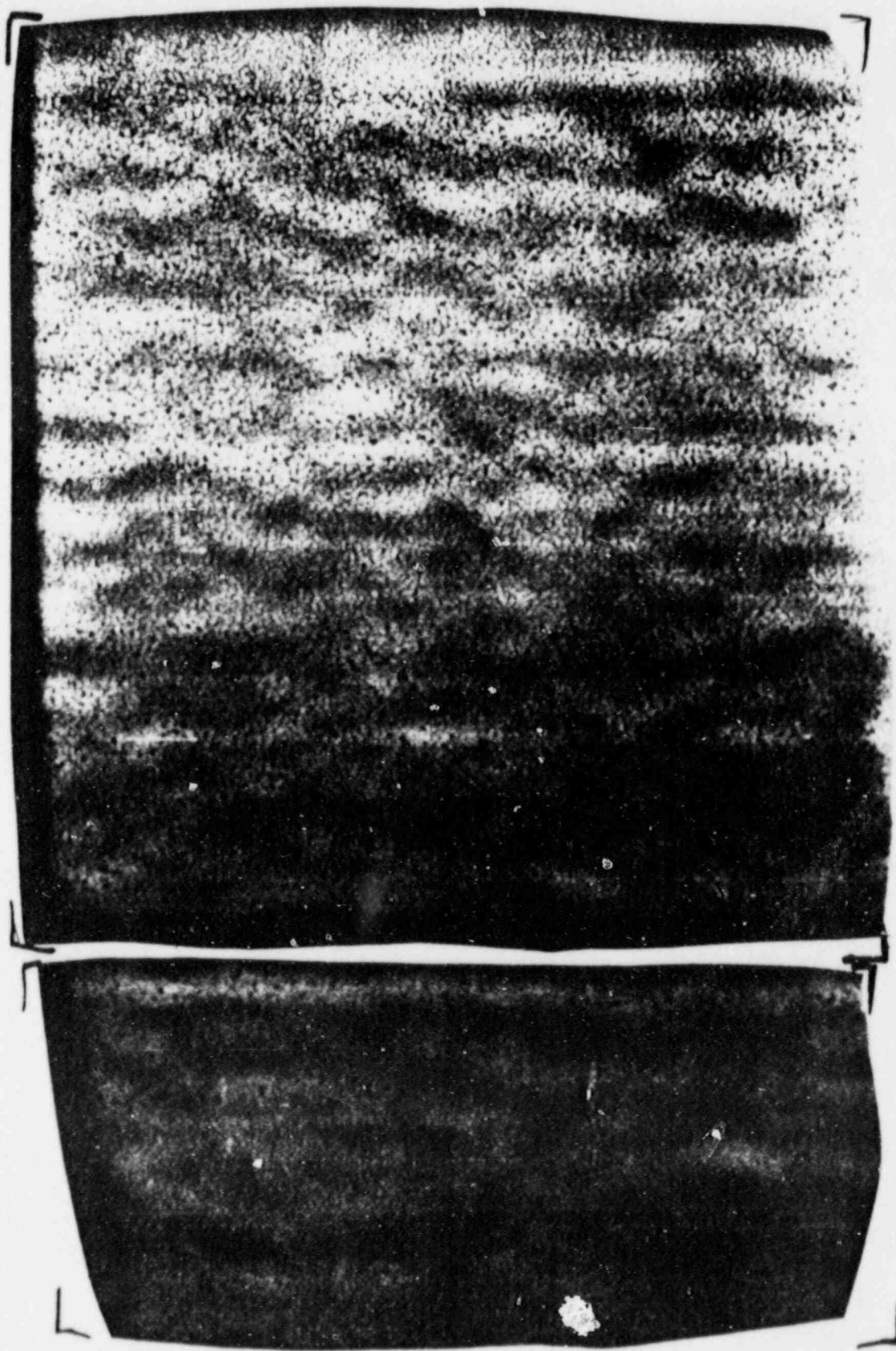
several difficult regulatory areas, including de minimis quantities, "frivolous" consumer products, imports from foreign countries, and economics. Because a multi-million dollar industry is involved, several interested reactor licensees and other parties have complained to the staff of unfair and inconsistent regulation, and insist on an expeditious resolution.

The staff has verified that two reactor licensees are irradiating topaz. The University of Missouri is distributing the gems in the U.S., and the University of Virginia is exporting the gems. The University of Missouri recently submitted a paper directly to the Commission explaining its position in favor of continued distribution; the University also recently applied for a distribution license. The staff has also received numerous reports of extensive imports of radioactive topaz from foreign suppliers, and reports of limited topaz irradiation in the past by other U.S. research reactors. We also have two applicants for distribution licenses, GA Technologies and Nuclear Theory and Technologies. Officials from these two companies complain that they are being economically penalized for complying with NRC requirements by requesting proper authorization prior to beginning distribution.

In attempting to resolve this situation, the staff has weighed the uncertainties in health risk and our strict policy against the use of even small quantities of radioactive material in jewelry, against economic considerations, apparent inconsistencies in policies among different countries, and the lack of de minimis regulations. The staff also recognizes that development of a comprehensive de minimis policy, revised consumer product policy, and appropriate rule changes cannot be accomplished in a short time. In the meantime, the staff seeks an expeditious solution to the complaint that licensees are being economically penalized for complying with NRC regulations.

Discussion:

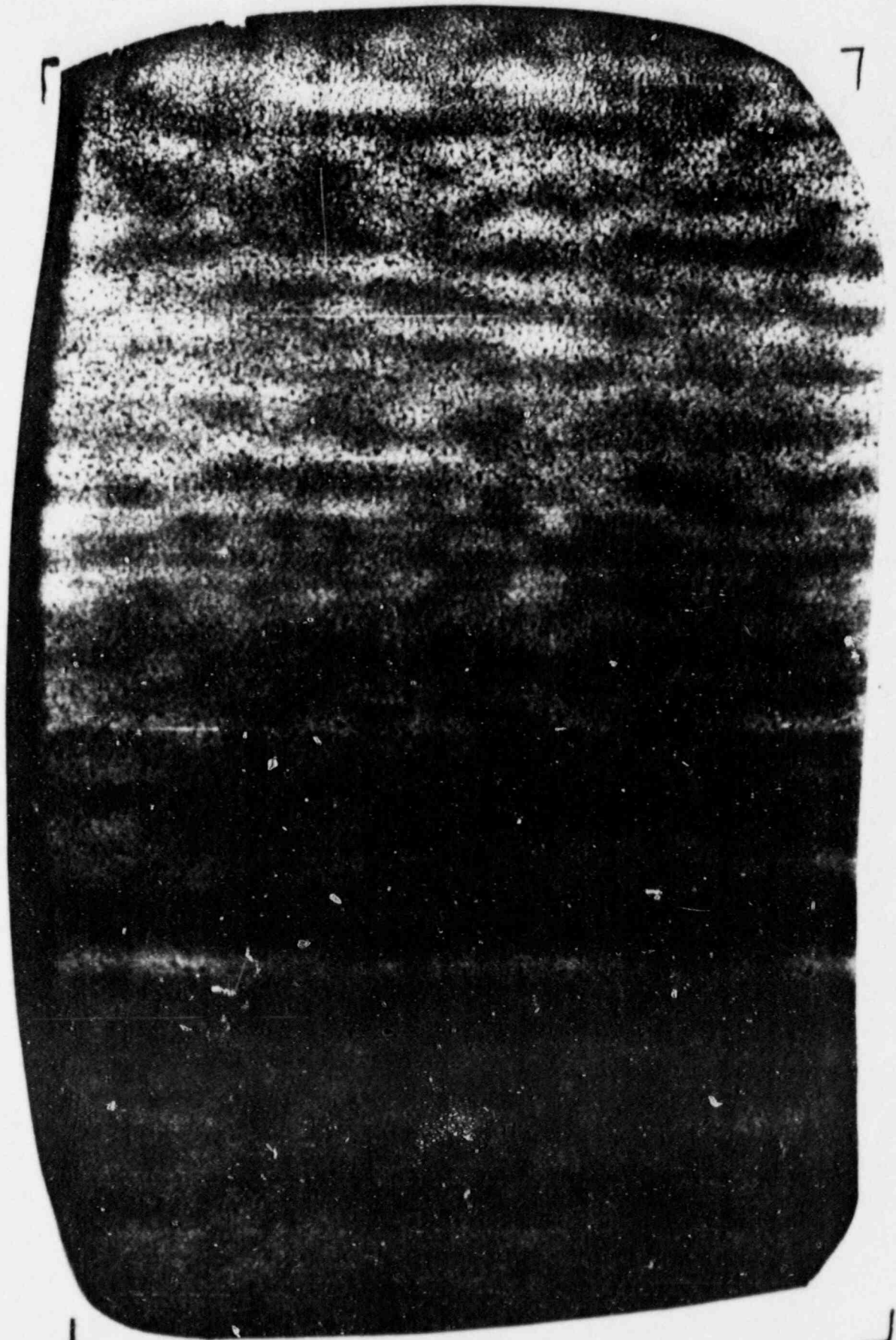


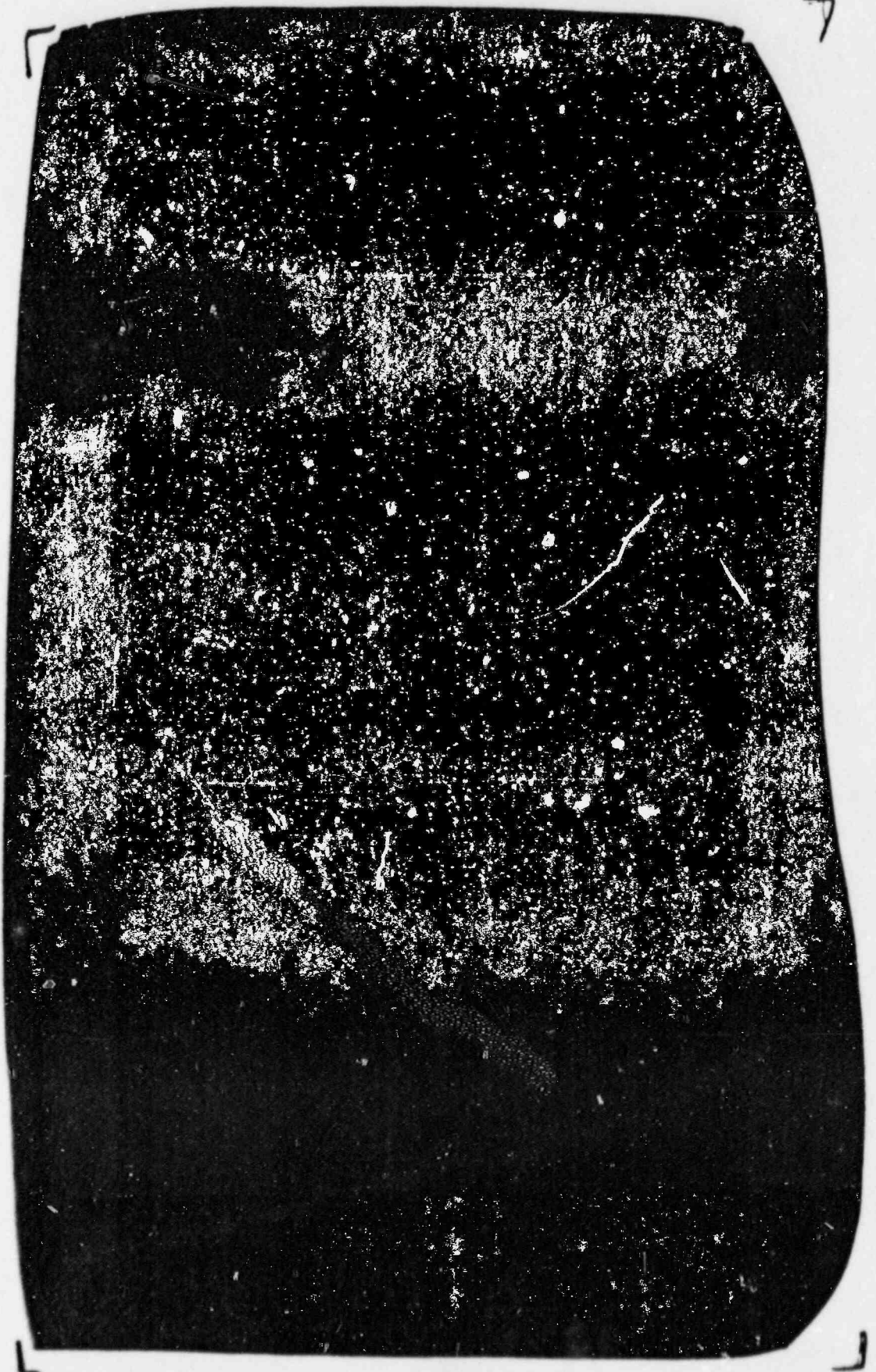


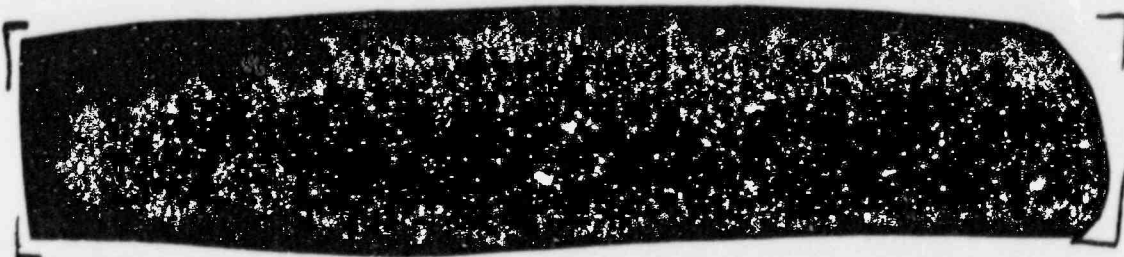
Alternatives:

The Commissioners

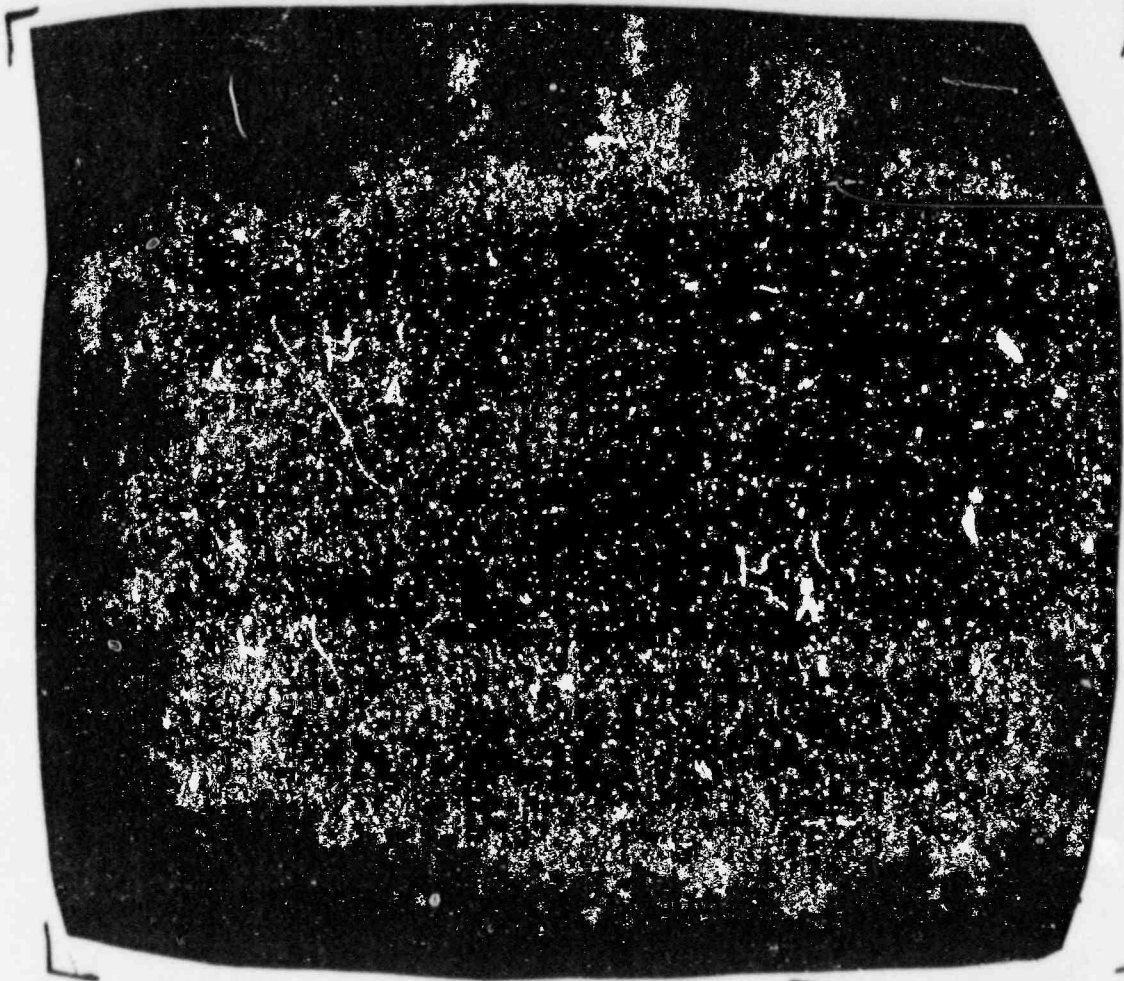
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Recommendation: That the Commission:



Victor Stello, Jr.
Executive Director for Operations

Enclosures:

1. Staff Response to Commissioners' Questions
2. Data on Irradiated Gem Industry
3. Technical Issues Associated with Distribution of Radioactive Gems

Commissioners' comments or consent should be provided directly to the Office of the Secretary by c.o.b. Thursday, October 22, 1987.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Thursday, October 15, 1987, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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Mr. Richard E. Cunningham
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

August 19, 1987

Dear Mr. Cunningham,

Enclosed please find a comprehensive report on the current state of the irradiated blue topaz market. This overview was requested by Mr. Stanley Lasuk of the Nuclear Regulatory Commission Region 3 during a phone conversation last month with Mr. Ray Zajicek, former president of the American Gem Trade Association.

Mr. Zajicek completed the drafting of this report and left it at our Dallas Headquarters for typing on the day he was leaving on a two week vacation. He has given me instructions and authority, as Executive Director of AGTA, to sign the report for him and forward a copy on to you.

Thanking you in advance for your most immediate attention to this important and timely information.

Sincerely,

A handwritten signature in dark ink, appearing to read "Peggy R. Willett", is written over the typed name.

Peggy R. Willett,
Executive Director
American Gem Trade Association



Mr. Stanley Lasuk
Nuclear Regulatory Commission
Region Three
799 Roosevelt Road
Glen Allen, IL 60137

August 18, 1987

Dear Mr. Lasuk:

Please excuse the delay in sending this report on the domestic and international irradiated blue topaz market. When we spoke a few months ago it seemed a relatively simple task to compile a few facts and figures about one small facet of the gemstone industry.

As I began asking questions and following suggested leads, however, the global picture focused into an entirely different perspective. It became apparent that over the last four to five years irradiated blue topaz has become a major factor, possibly even a mainstay of today's gemstone and jewelry industry.

In fact it may be more accurate to describe blue topaz as a sub-industry within the international colored gemstone and jewelry industries.

This letter would still be weeks away from completion had it not been for the fact that I was assisted by Roland Naftule, President of the International Colored Gemstone Association (ICA), an organization representing the major gemstone suppliers and exporters throughout the world.

Our job was facilitated greatly by our attendance at the Jewelers of America trade show in New York last month. There we had the opportunity to survey producers, distributors, and manufacturers from around the world who were exhibiting at the show. Also entailed in this research project were numerous telephone conversations, both domestic and international. Our interviews included:

MINE OWNERS and ROUGH EXPORTERS from Africa and Brazil.
OWNERS OF CUTTING FACTORIES in Asia and Brazil.
IRRADIATION PROCESSORS from Europe and North America.
WHOLESALE DISTRIBUTORS and JEWELRY MANUFACTURERS from
Asia, Brazil, Europe and North America.
MAJOR RETAILERS from America, Brazil, and Europe.

Page 2 to Mr. Lasuk

The figures resulting from our survey are mind-boggling. In trying to theorize the "why" of the blue topaz market phenomena, one must have a broader understanding of the colored gemstone industry.

Natural blue topaz has been on the market for many decades. Occuring in areas with high concentrations of uranium or other radioactive minerals, its light blue color is the result of natural low-level irradiation.

With the discovery in the late 1970's that man-induced high-level radiation could impart various shades of blue to most white topaz, an enormous potential market opened up.

Traditionally, blue is one of the most popular colors in fashion from clothes to cars to jewelry. Previously, however, there was limited availability and accessibility for blue gemstones;

AQUAMARINE - generally a medium to light pastel color, almost colorless in smaller sizes. Darker and larger stones are rare and very expensive.

NATURAL BLUE TOPAZ - only available in the same lighter colors as aquamarine. Less expensive than aquamarine but also so rare that there was not sufficient supply to establish a market.

INDICOLITE (BLUE TOURMALINE) - fine shades of blue are found in small and large sizes, but this gemstone is so rare as to be almost unknown in the world market. In the nicest blue tones it is very expensive due to the limited supply.

IIOLITE - also known as "water sapphire," this gem type offers little consistence of color and generally occurs in very small sizes.

SAPPHIRE - the most reknowned and popular of all blue gemstones, but prohibitively expensive for the general public.

SPINEL - this gem occurs naturally in almost every color of the rainbow. Pure blue, however, is one of the scarcest of its varieties and is almost non-existent in sizes over 1 carat. Fine blue stones are collectors items and are as expensive as they are unique.

ZIRCON - a very soft stone, it is easily scratched when worn as jewelry. Certain types of brown zircon can be heat treated to a pleasant light to medium blue color. Unfortunately the results from heating are very erratic and unpredictable. No one has ever been able to produce a dependable enough supply to create a solid market.

Enter **IRRADIATED BLUE TOPAZ** - a durable gemstone which offers the market virtually unlimited quantities of every shade of blue imaginable in sizes ranging from 0.10 carat to 1,000 carats at extremely affordable prices.

It works perfectly for the price-point concious catalog companies using smaller sizes of the gemstone for inexpensive mass-produced jewelry and it is just as attractive to the "carriage trade" manufactureres who use enormous quantities of 10 to 20 carat standard sizes for their high-fashion but affordably priced lines.

With these considerations it is not really such a mystery that this product has become such an international hit so quickly. For the gemstone and jewelry industry the timing of blue topaz's market entry could not have been better.

In the early 1980's the production increased dramatically. The resulting popularity and growing public consumption came at a time when the jewelry industry was in the depths of economic depression. Many wholesalers and manufacturers even allude to the fact that blue topaz was their "salvation" during the hard times.

Today, with the market recovering to a reasonably healthy state, blue topaz continues to flourish. It surpasses almost every other gemstone in retail jewelry sales (see enclosed National Jeweler article.)

Even corundum dealers, who heretofore worked exclusively with ruby and sapphire, are now becoming a force in the blue topaz market because it has proved itself to be an extremely liquid commodity that can be sold worldwide in enormous quantities.

Obtaining prices and accurate information for this overview was impeded somewhat by the competitive and proprietary nature of the industry. Rough sources and prices, irradiation facilities, formulas, costs, quantities, and customers are all closely guarded pieces of information that each producer believes gives the advantage over the competition. Thus we compiled our facts and figures from various sources at each level of production and calculated by consensus and averages.

To quickly review the results of our study we have prepared a chart summarizing the more salient information:

Summary chart of information about the blue topaz industry

	est. number of people involved	est. % of yearly income	est. int'l yearly weight volume	est. int'l. yearly dollar volume	approx. U. S. market share
MINING	4,000	95%	200 Tons	\$15 Million	not applicable
CUTTING	10,000	95%	6,000 Kg	\$20 Million	not applicable
COLOR PROCESSING	200	75%	6,000 Kg	\$15 Million	40% *
WHOLESALE BLUE TOPAZ DISTRIBUTION	1,000	30%	5,000 Kg	\$125 Million	35% *
WHOLESALE JEWELRY MANUFACTURING AND SALES	10,000	30%	4,000 Kg	\$200 Million*	40%
RETAIL SALES	10,000	15/20%	3,000 Kg	\$300 Million*	80%

* blue topaz only ; gold and diamonds not included

* until last year these figures exceeded 95%

The vertical classifications describe each phase of production to which any piece of topaz is subjected from digging it out of the ground until it is surrounded by gold and diamonds and purchased for the happiness and pleasure of the consumer.

To give an idea of the global nature of this market, below are listed the countries which play the largest part in each respective stage of the product's development:

MINING - Australia, Brazil, India, Nigeria, and Sri Lanka

CUTTING - Brazil, China, Germany, Hong Kong, Korea, Sri Lanka, Taiwan, and Thailand

COLOR PROCESSING - Australia, Brazil, Canada, China (?), England, Germany, India (?), Sweden, Switzerland, and U. S. A.

(Note: (?) indicates strong possibility, but no hard evidence.)

BLUE TOPAZ WHOLESALE DISTRIBUTION - England, Germany, Hong Kong, Thailand, and U. S. A.

WHOLESALE JEWELRY MANUFACTURING AND SALES - Brazil, France, Germany, Hong Kong, Italy, Japan, Taiwan, Thailand, and U. S. A.

RETAIL - all countries that sell retail jewelry

The time frame concerning this production cycle varies greatly depending on the season, the size of the operation and whether the goods are for general stock or to fill special orders. For your purposes the most important consideration must be the time between the gemstones' release from the reactor facility to the time a piece of blue topaz jewelry becomes an adornment for the consumer.

We assume that the topaz is color-treated in its finished faceted and polished state, as we understand is the case at American and European facilities. Obviously, if the material were irradiated in its rough or preformed state there would be added complications in terms of quantities handled and residual waste and sludge during the cutting.

Once the topaz has been irradiated it is held by a licensed facility to cool down to the appropriate levels of activity for release to the producer according to the regulations to which that facility is subject. Depending on the material and the process used the holding period could be from six weeks to two years.

Generally producers wait for enough material to cool so that they can receive between one and five kilograms per batch. Then the stones are sorted for breakage, size, shape, and color quality. Finally, they are packaged for distribution. On the average we estimate that between 250 and 400 carats per day can be properly sorted, classified, and packaged by each employee. A given kilogram of irradiated blue topaz will stay with the producer a minimum of eight to 8 to 14 weeks for preparation and sale.

The next level of distribution is the wholesale gem dealer. Depending on the company's size and the time of year, blue topaz purchases are made in the range of 0.25 to 5.0 Kg per month in addition to numerous other gems types with which they work. Small quantities of the stones are carried out on the road as samples, but the bulk of the wholesaler's inventory is kept locked in the office vault awaiting orders for specific sizes and shapes from the manufacturing customers. On the average, a kilogram of blue topaz takes at least 6 to 12 weeks for a good wholesaler to distribute.

Typical blue topaz mail shipments to manufacturers are from 0.01 Kg to 0.5 Kg. When the goods are received they are dispensed, along with other gem types used in the same line, to the goldsmiths and setters for fashioning into the finished pieces of jewelry. A good setter might handle between five and fifty gemstones a day (not necessarily all topaz) according to the stone's size and shape and the type of mounting. Completing this evolution from gemstone to jewelry, a topaz will finally be sent out to fill a retailer's order about 4 to 10 weeks after being purchased by the manufacturer.

Once the piece has arrived at the retailer's, the turnover rate is extremely sporadic. During the Christmas season the blue topaz treasure may be sold within a week or two. If it sits in the off-season showcase, however, the same topaz might not find its permanent home from 6 to 9 months or more.

Between each of these stages we must add a conservative one week shipping and handling time. By averaging the time periods required during each phase of production, we estimate that the typical delay required for an irradiated blue topaz to reach a retail jeweler's showcases after being released from a laboratory is approximately 30 weeks. Then from the showcase to the consumer could take from 1 week to 1 year.

Referring back to the chart, the horizontal headings demonstrate a quantitative idea of the magnitude and economic impact of the irradiated blue topaz market:

ESTIMATED NUMBER OF PEOPLE INVOLVED - these figures do not overlap. Miners do not do cutting, cutters do not do color processing, etc. To summarize, our best estimates indicate that the international blue topaz industry significantly affects the livelihood of approximately 35,000 people.

ESTIMATED % OF YEARLY INCOME - shows to what extent the participants in each phase of production depend upon the topaz industry for their subsistence. The most notable figures are at the mining and cutting level where approximately 14,000 people would effectively have no means of support without this market. By extending these figures to include the miners' and cutters' immediate families there are in excess of 56,000 lives financially dependent on the topaz industry.

ESTIMATED WEIGHT VOLUME - The weights diminish from one stage to the next because we have allowed for breakage, loss and unsold inventory during a twelve month period. The yearly volumes also take this into account.

ESTIMATED YEARLY DOLLAR VOLUME - these figures do not overlap at any stage. New money is being exchanged between the countries as the topaz passes through each stage of production. Therefore, considering only the gemstones, excluding the diamonds and gold used in the mountings, this is a \$675 million per year industry.

ESTIMATED U.S. MARKET SHARE - until recently American knowhow and technology allowed U.S. producers to control almost 100% of the processing and wholesale distribution of blue topaz. Last year most domestic irradiation facilities were forced to interrupt the release of irradiated topaz while the NRC decides its official position on the subject. Fearing possible fines and/or penalties, many laboratories stopped production altogether. To protect their heavy long-range investments and commitments most producers took their technology abroad and began working with foreign irradiation facilities and wholesalers.

Page 6 to Mr. Lusak

Today the tables have turned. American gem dealers and manufacturers must buy 60 to 70% of their blue topaz from foreign partnerships while U.S. producers have very little product to sell at home or abroad.

The decline of America's share of this immense market is tangibly accelerating at an astonishing rate. As the U.S. sales figures are now decreasing on a weekly basis, there is one glaring question that greatly concerns the AGTA and the American jewelry industry as a whole: why is the NRC taking so long in arriving at a responsible decision to give us guidelines whereby our industry can act and compete internationally?

The U.S. production advantage is history as our technology and knowhow has been sold out. However, if this government agency continues to delay its decision our own producers and wholesalers will no longer even maintain an equal hand in the world market.

I have been told that the NRC feels no urgency to take a favorable position because it considers the color enhancement of gemstones a "frivolous" use of energy. If the hard line negative position is taken, perhaps someone at the NRC would like to explain that attitude to the 14,000 families who depend on a healthy blue topaz market for their survival.

Considering that this industry generates in excess of one-half billion dollars per year, this indecision is actually adding to our country's current trade deficit problem. We are forfeiting what was once a lucrative source of foreign money while losing precious U. S. dollars by leaps and bounds to an overseas market which American ingenuity invented, developed and dominated for years. Where is the logic?

Public safety cannot possibly be the issue being considered in Washington. For more than 18 months the NRC has tacitly approved Region Three's guidelines for the wholesale release of irradiated topaz. This was admitted at our November meeting with Mr. Hickey, Mr. Cunningham, et al.

So the NRC has for quite some time, and without enforcing any specific licensing requirement, knowingly allowed the release of massive quantities of this irradiated by-product for domestic distribution and public consumption. Clearly Washington must have decided that your region's criteria for release presented so little public safety hazard that a special license was not even necessary.

On the other hand I am told that all research reactors have been directly prohibited from releasing any irradiated blue topaz without a specific license which has never been issued. Apparently there is some major confusion in Washington at the expense of our industry.

Over the last five years, American entrepreneurs have invested tens of millions of dollars in the R&D and production of blue topaz. This money would never have been spent if there were any question of public safety or any inkling that production could be prohibited.

The NRC's long standing implied approval of Region Three's release guidelines reassured American producers that their investments were protected. There was no threat felt even by those working at facilities that were temporarily restrained from releasing irradiated topaz while the NRC studied and drew up its official position. The producers understood delays with government agencies, but considering Region Three's approved activity, there was no doubt that the eventual outcome would be favorable. Therefore the long-range investments continued.

Today the NRC's prolonged decision making is already becoming costly to our American producers in terms of lost profits. Hopefully, these delays do not indicate the possibility of an unfavorable decision. This eventuality would unquestionably force many U. S. tax paying business, large and small, into bankruptcy.

This survey makes it obvious that blue topaz is not a "flash in the pan" fad...it is here to stay. Whether the NRC makes up its mind now or in ten years, blue topaz will continue to be produced somewhere in the world to supply the enormous demand.

As long as our American producers' hands are tied a different but very serious safety risk is increased. Eventually the technology will spread to underdeveloped countries (if it has not already), where there is much less control over release criteria. The NRC, in its current mode of operation, is actually forcing this to happen.

If, as the rumors go, the NRC makes the mistake of halting all domestic topaz irradiation they might compound that error by banning the import of all blue topaz. Considering the variety of other blue gemstones on the market, customs would have to open and check every package containing gemstones to make sure they weren't topaz in disguise.

In fact this course of action would simply drive the industry underground, thereby drastically increasing the risk to public health beyond any acceptable level.

If the NRC has the public's help in mind it is the immanent responsibility and obligation to make a timely decision and to issue relevant and safe guidelines within which our industry can operate.

The leading wholesalers and manufacturers are already aware of the safety considerations. Most of them have in-house survey meters to check all blue topaz that enters their office. Unfortunately, there is no standardization to the equipment and no established guidelines with which they can work.

I am enclosing a copy of "The Jewelry Industry Gemstone Enhancement & Man-Made Product Information Guide" and a recent article from the L. A. Times business section. As these enclosures indicate, our associations are extremely concerned with and supportive of full disclosure of any and all gemstone color-enhancement techniques.

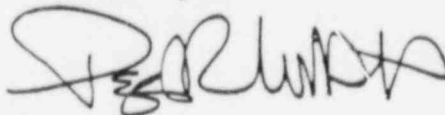
AGTA members are already coding invoices to specify gemstones that have been treated in any way to ensure that the wholesale buyer and the consumer know exactly what they are getting.

Page 8 to Mr. Lusak

As we have stated in our October, 1986 letter to John Davis, Director of NMSS, and as we reiterated during subsequent correspondence and phone conversations to other NRC officials, the AGTA and ICA stand ready and eager to monitor the market here and abroad. We have the means to make sure that all producers, importers, and wholesalers work within NRC standards and regulations. Both of these organizations were conceived and founded for the specific purpose of bringing a new stability, responsibility, and professionalism to the gemstone industry.

Now we look to you and the Washington headquarters to give us something by which to accomplish these goals as they pertain to irradiated blue topaz.

With best regards,



Peggy Willett
Executive Director
American Gem Trade Association
signing for
Ray Zajicek
Immediate Past President
American Gem Trade Association

cc: Mr. Robert Bernero
Mr. Richard E. Cunningham
Mr. John W. Hickey
Mr. John G. Davis
Hon. Lando W. Zech, Jr.
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Hon. Kenneth M. Carr
Hon. Kenneth C. Rogers

Hon. Alan Cranston
Hon. Pete Wilson

THE JEWELRY INDUSTRY
GEMSTONE ENHANCEMENT
&
MAN-MADE PRODUCT
INFORMATION GUIDE

Foreword

This information guide has been developed by a coalition of jewelry industry leaders representing the associations listed below. Should you require any further information, please contact:

American Gem Soc'ety (AGS)

5901 West Third Street
Los Angeles, CA 90036-2898
(213) 936-4367

American Gem Trade Association (AGTA)

Post Office Box 581043
Dallas, Texas 75258
(214) 742-4367

Jewelers of America, Inc. (JA)

1271 Avenue of the Americas
New York, New York 10020
(212) 489-0023

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New York, New York 10036
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Michael Roman
Mathew Runci
Joel Windam
Ray Zajicek*

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First Edition - January 1987
Printed in the United States of America

Note: A Review Board, consisting of association representatives and laboratory technical advisors will meet from time to time to make necessary modifications to this industry guide.

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INSTRUCTIONS

To obtain copies of The Jewelry Industry Gemstone Enhancement and Man-Made Product Information Guide or consumer information cards, please place your order, in writing, to any of the National Associations listed on the preceding page.

Consumer Information cards are presently available for the following gemstones:

Alexandrite	Lapis-Lazuli
Amber	Nephrite
Amethyst	Onyx
Aquamarine	Opal
Cats'-Eye	Pearl (Cultured)
Chrysoberyl	Peridot
Citrine	Ruby
Colored Diamond	Sapphire
Coral	Spinel
Diamond	Star Corundum
Emerald	Tanzanite
Garnet	Topaz
Iolite	Tourmaline
Ivory	Tsavorite
Jadeite	Turquoise
Kunzite	Zircon

Gemstone Enhancement & Man-Made Product Information Guide

Following is a proposal to implement at the point of sale, a system whereby information regarding "man-made product and the enhancement or non-enhancement of each gemstone is made known to the buying public. It is a system which is expandable based on future needs and discoveries. The tagging code, made up of one or two parts, is to be used by all wholesale suppliers and retail merchants.

DEFINITION

ENHANCEMENT: Any process other than cutting and polishing used intentionally to improve appearance (color/clarity), durability or availability of a gemstone.

The general category (tag code column #1) requires that the supplier provide one of three basic designations in order to satisfy the minimum standard for the disclosure of enhancements.

- A - The A symbol used alone indicates either a gemstone that is not currently known to be enhanced (alexandrite, garnet, etc.), or one that is so rarely enhanced, that to give it an E symbol would mislead the public (i.e. colorless or near colorless diamonds that have not been laser drilled).
- E - The E symbol indicates the gemstone is one that is often enhanced. The method and frequency are listed on the chart. Sellers specifically responsible for the enhancement must use the tag code listed in column #2.

*Man-Made when used in this guide refers to synthetic, imitation, or assembled stones.

N - The N Symbol in tag code column #1, for a gemstone that would usually have an "E" designation, indicates that the gemstone is accompanied by documentation to support the fact that the stone is **NOT** enhanced. The supporting documentations could be supplied by an independent source, such as a laboratory, or provided by the seller of the gemstones as a personal guarantee of authenticity.

Example

GEMSTONE	Tag Code		ENHANCEMENT
	1	2	
GARNET	A		Not currently known to be enhanced. Often enhanced. Heated to modify color. No enhancement with supportive documentation.
SAPPHIRE (Blue)	E		
	N	H	

Designations

A. Frequency Designations

1. Rarely (0 - 10%)
2. Occasionally (10 - 25%)
3. Commonly (25 - 50%)
4. Usually (50 - 95%+)
5. Always (100%)

B. Stability Designation

1. Excellent
2. Very Good
3. Good
4. Fair
5. Poor

C. Care Designations

1. Normal
2. Special

D. Multiple Enhancement Techniques are sometimes applied to the same material. The most significant process should be listed first.

Example:

1. Diamond R - Irradiation
L - Lasering
2. Topaz (Blue) R - Irradiation
H - Heat

GEMSTONE ENHANCEMENT INFORMATION GUIDE

Every tag, stone paper, container, invoice and memorandum must have at least one letter.

Column #1 Entries (general):

A - Indicates gemstones that are not currently known to be enhanced, or that are very rarely enhanced.

N - Indicates that a specific gemstone has **Not** been enhanced and there is documentation to support it.

E - Indicates the gemstone is one that is often enhanced. The method and frequency is listed on the chart. Sellers specifically responsible for the enhancement must use the tag code listed in Column #2.

Column #2 Entries (specific):

B - Bleaching: The use of chemicals or other agents to lighten a gemstone's color.

- C - Coating:** The use of such methods as lacquering, enameling, inking, foiling, sputtering of films to improve, provide color or add other special effects.
- D - Dying:** The introduction of coloring matter into a gemstone to give it a new color, intensify present color or improve color uniformity.
- F - Filling:** The masking of surface cavities usually with molten glass or plastic to improve appearance.
- H - Healing:** The intentional use of heat to effect desired alteration of color and/or clarity.
- I - Impregnation:** General infusion of a substance such as colorless paraffin or wax into a porous material.
- L - Laserling:** The use of a laser and chemicals to reach and alter objectionable inclusions in diamonds.
- O - Oiling:** The penetration of colorless oil into voids and faults to improve overall appearance.
- P - Stabilization:** The use of a colorless bonding agent within a gemstone to improve durability and appearance.
- R - Irradiation:** The use of high energy or sub-atomic particle bombardment to alter and improve a gemstone's color. Often followed by a heating process.
- U - Surface Diffusion:** The use of high temperature and chemicals resulting in the shallow penetration of near surface coloration and/or asterism in a gemstone.

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		Method	Frequency Used	Stability	Care Required	CONSUMER CARE	
	1	2						
ALEXANDRITE	A	E	I	Waxed or oiled to improve appearance.	Commonly	Good	Special	Avoid heat, chemicals and ultra-sonic.
AMAZONITE	E	E	H	Heated to improve appearance, add "sun spangles" or deepen color.	Occasionally	Good	Normal	Avoid chemicals and ultra-sonic.
AMBER	E	D	D	Dyed or surface treated to add color.	Rarely	Good	Normal	Avoid repolishing surface.
AMETHYST	A	H	H	Heated to lighten color.	Rarely	Excellent	Normal	
ANDALUSITE	A	H	H	Heated to improve color.	Commonly	Excellent	Normal	
AQUAMARINE	E	H	H	Heated to improve color.				

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
BERYL							
"Maxixe" Type	E	R	Irradiated blue from pale pink.	Rarely	Poor	Special	Color fades in light.
Pink	E	H	Heated from orangy colors.	Occasionally	Excellent	Normal	
Yellow-Green	A						
Red	A						
Yellow	E	R	Produced by irradiation.	Occasionally	Good	Normal	
CHALCEDONY							
Agate	E	D	Dyed	Usually	Excellent	Normal	
Onyx (black)	E	D	Dyed	Usually	Excellent	Normal	
Carnelian	E	H,D	Heated or dyed to produce color.	Commonly	Excellent	Normal	
Jasper	A						
Chrysoprase	A						
CHRYSOBERYL							
Cats'-Eye	A						
Transparent							
Varieties:							
Yellow	A						
Brown	A						
Green	A						
CITRINE	E	H	Produced by heating various quartzes.	Usually	Excellent	Normal	

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
CORAL							
Black	A					Special	Avoid chemicals, abrasives and cosmetics.
White	E	B	Bleached	Commonly	Excellent	Special	Same as above.
Pink	A					Special	Same as above.
Orange	A	B	Bleached from black coral.	Commonly	Excellent	Special	Same as above.
"Gold"	E	D	Dyed	Rarely	Good	Special	Same as above.
Red	E					Special	Same as above.
DIAMOND							
Colorless	A	L	Laser drilled to improve appearance.	Occasionally	Excellent	Normal	
		C	Coated to disguise off color.	Rarely	Fair to Good	Special	Will lose color with recutting.
DIAMOND							
Colored	E	R	Irradiated and/or heated to induce fancy colors.	Occasionally	Excellent	Normal	Avoid heating treated greens as they may fade.

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
EMERALD	E	O	Oiled to improve appearance.	Commonly	Good	Special	Avoid temperature changes, chemicals, and ultra-sonic.
		D	Dyed with colored oil.	Occasionally	Good	Special	Same as above.
GARNETS	A						
Almandine	A						
Demantoid	A						
Grossularite	A						
Pyrope	A						
Rhodolite	A						
Spessartite	A						
Tsavorite	A						
HEMATITE	A						
KOLITE	A						
IVORY & BONE	E	B	Bleached to whiten and remove discoloration.	Commonly	Very Good	Special	Avoid chemicals and ultra-sonic.
		D	Dyed for artistic purposes.	Occasionally	Good	Special	Same as above.

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
JADE							
Jadeite	E	D	Dyed to imitate natural colors.	Commonly	Good	Special	Avoid strong light, chemicals and ultra-sonic.
Nephrite	A	D	Dyed to alter color or for artistic purposes in carving.	Rarely	Good	Special	Avoid chemicals.
KUNZITE	A						
LAPIS-LAZULI	E	D	Dyed to provide color and uniformity.	Occasionally	Good	Special	Avoid chemicals and ultra-sonic.
		I	Impregnated with wax or oil to improve appearance.	Occasionally	Good	Normal	
MALACHITE	A					Special	Avoid chemicals and abrasives.
MOONSTONE	A						

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
OPAL Black or Gray Boulder White	A	O	Oiled to hide crazing.	Rarely	Fair	Special	Avoid heat, chemicals and ultra-sonic with all opals.
		I	Impregnated with plastic to hide crazing.	Rarely	Good	Normal	Same as above.
	A	O	Oiled to hide crazing.	Rarely	Fair	Normal	Same as above.
		I	Impregnated with plastic to hide crazing.	Rarely	Good	Normal	Same as above.
	A	D	Dyed with colored plastic.	Rarely	Good	Normal	Same as above.
		O	Oiled to hide crazing.	Rarely	Good	Special	Same as above.
		I	Impregnated with plastic to hide crazing.	Rarely	Good	Normal	Same as above.

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
OPAL (continued) Matrix	A	D	Special type takes dye to appear black.	Commonly	Fair	Special	Avoid repolishing or recutting.
PEARL Natural Cultured	E	B	Bleached to improve color and appearance.	Commonly	Excellent	Special	Avoid cosmetics and household chemicals.
		D	Dyed black.	Rarely	Good	Special	Same as above.
	E	B	Bleached to improve color and appearance.	Commonly	Good	Special	Same as above.
		D	Dyed to give rosy tint. Dyed blue and black.	Commonly Occasionally	Good Good	Special Special	Same as above. Same as above.
PERIDOT	A	R	Irradiated to produce blue and gray colors.	Occasionally	Good	Special	Same as above.
						Special	Avoid sudden temperature changes.

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
RHODONITE RUBY	A						
	E						
		H	Heated to improve color and appearance.	Commonly	Excellent	Normal	
		D	Dyed with colored oil to improve appearance.	Rarely	Fair	Special	Avoid household chemicals and ultra-sonic.
		F	Surface cavities filled with a foreign material including glass.	Rarely	Fair to Good	Special	Foreign material is fragile and may fall out.
SAPPHIRE (All colors)		U	Diffusion of color on surface or surface asterism.	Rarely	Good	Special	Avoid repolishing or recutting.
	E						
		H	Heated to produce or intensify color; make color uniform, or to lighten stones.	Usually	Excellent	Normal	
		U	Diffusion of color on surface or surface asterism (blue only)	Rarely	Good	Special	Avoid repolishing or recutting.

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
SAPPHIRE (Continued)							
		R	Irradiation of yellow stone to provide temporary intense yellow or orange color.	Rarely	Very Poor	Special	Fades quickly in light.
SERPENTINE	E						
		D	Dyed various colors.	Commonly	Good	Normal	
SODALITE	A						
SPINEL	A						
TANZANITE	E	H	Heated to produce violet-blue color.	Usually	Excellent	Special	Avoid sudden temperature changes.
TOPAZ-Blue	E	R	Irradiated and heated to produce color.	Usually	Excellent	Normal	
TOPAZ Yellow/Orange	E	R	Irradiated to intensify color.	Occasionally	Good	Special	Avoid heat and strong light.
Pink	E	H	Heated from certain brown stones.	Usually	Excellent	Normal	

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
TOURMALINE Chrome/ vanadium Cats'-Eye Yellow/Orange Green, Blue Pink, Red, Purple	A						
	A						
	A						
		H	Heated to improve color.	Rarely	Excellent	Normal	
		H	Heated to improve color.	Commonly	Excellent	Normal	
		R	Irradiated to improve color.	Occasionally	Very Good	Normal	
		H	Heated to improve color.	Occasionally	Excellent	Normal	
		R	Irradiated to intensify color.	Occasionally	Very Good	Normal	
TURQUOISE		P	Stabilized with colorless bonding agent to improve durability and appearance.	Occasionally	Very Good	Normal	
	E	P	Stabilized with plastic to improve color and durability.	Commonly	Good	Normal	

GEMSTONE ENHANCEMENT INFORMATION GUIDE

GEMSTONE	Tag Code		ENHANCEMENT			CONSUMER CARE	
	1	2	Method	Frequency Used	Stability	Care Required	Special Advice
TURQUOISE (Continued)		I	Impregnated with oil or wax to enhance color.	Commonly	Fair to Good	Special	Avoid hot water and household chemicals.
		D	Dyed to improve color.	Rarely	Poor	Special	Same as above.
ZIRCON Yellow, Brown and Green Blue, Colorless and Red	A						
		H	Heated brown crystals turn these colors under certain conditions.	Always	Good	Normal	Avoid abrasives.

MAN-MADE PRODUCT GUIDE

Any synthetic, imitation, or assembled product must have on its tag the appropriate symbol indicated in the man-made product guide.

Note: Synthetic, imitation, or assembled product should be clearly identified as such on every stone paper, container, invoice and memorandum.

MAN-MADE PRODUCT GUIDE

TYPE	TAG	DEFINITION	COMMON EXAMPLES	CARE REQUIRED	SPECIAL ADVICE
Synthetic (laboratory grown)	SS	A laboratory grown material that exhibits essentially the same physical, optical and chemical properties as its naturally occurring counterpart.	Synthetic Alexandrite, Amethyst, Emerald Ruby, Sphire, Spinel Zirconia/Cubic (a diamond simulant) Opal	Normal	Avoid sudden shocks and temperature changes, household chemicals, cosmetics and abrasives.
				Normal	
				Normal	
Imitation	MM	Laboratory grown material, other than glass and plastic, that is used to simulate the appearance, but not necessarily duplicate the properties of a natural gemstone.	YAG GGG Strontium Titanate	Special	Same as above.
				Normal	
				Normal	
	YY	Manufactured product, fabricated in glass or plastic to imitate or resemble the appearance, but not the characteristic properties of a natural gemstone.	Glass Plastic	Special	Same as above.
				Special	
				Special	

TYPE	TAG	DEFINITION	COMMON EXAMPLES	CARE REQUIRED	SPECIAL ADVICE
Assembled	ZZ	Multiple layers or combinations of manufactured and/or natural materials fused, bonded, or otherwise joined together to imitate the appearance of a natural gemstone, create a unique design or generate unusual color combinations.	Opal (various combinations) Garnet/Glass Sapphire/Synthetic Sapphire Colorless Beryl/Green bonding and/Colorless Beryl	Special Special Special Special	Avoid sudden shocks and temperature changes, household chemicals, cosmetics and abrasives with all assembled stones.

Note: Some synthetics imitate gemstones that do not have the same optical, physical and chemical composition.

(e.g. light blue synthetic spinel imitate aquamarine; light purplish synthetic sapphire imitate natural alexandrite; dark blue synthetic spinel imitate natural blue sapphire; brownish-red synthetic ruby imitate red garnets, etc.)

Enclosure 3

Technical Issues Associated with Distribution of Radioactive Gems

For the radionuclides normally contained in irradiated topaz, the exempt concentration limit is about 0.4 nanocuries per gram. The University of Missouri and GA Technologies have proposed release limits above our exempt concentration limits. The University of Missouri requested a release limit of about 0.6 nanocuries per gram, and GA Technologies requested 2 nanocuries per gram. The staff does not recommend an exemption to allow distribution of gems to the public if they contain radioactivity above exempt concentration limits (i.e., licensable quantities). Section 32.11(c) prohibits radioactive material in products designed for "application to a human being," but exemptions could be granted pending review of the issue, in light of the assumed low hazard involved.

With respect to interim release limits for irradiated gems, the most straightforward choice would be the exempt concentration limits, because they are already specified in the regulations. There is a question as to whether these limits would provide adequate health protection, because the regulations are over 20 years old and were not developed to protect against products which are worn for long periods of time in direct contact with the body. However, the information currently available to the staff indicates that the current exempt concentration limits would provide adequate protection for gems. The staff would continue to gather data, and could impose a lower limit at a later date if necessary. The staff would also review the quality control procedures of applicants, to assure that screening methods were adequate to prevent release of gems with excess levels of radioactivity.