ANTI-CORROSION TIMES

REPORTING ON INDUSTRY NEWS, NOTEWORTHY APPLICATIONS & NEW DEVELOPMENTS ON FUSION BONDED EPOXY COATINGS FOR CORROSION PROTECTION ON STEEL REBAR.

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In this edition

Detroit Metro Airport Concrete Placement Sets New Record

Heavy concrete placement reached a new plateau at the fifth busiest airport in the world, the Detroit Metropolitan Airport. This was accomplished while overcoming an almost limitless potential for logistical and safety problems among the live runways.

The contracting firm of Walbridge Aldinger, Detroit, Mich., set the performance bar higher when 20,917 yd^3 (16,000 m^3) of concrete were placed in a time span of 22 hours, 57 minutes on May 15-16, 1999, for the mat foundation of the North Tunnel Project at the airport. A 4 ft (1.2 m) thick foundation, 950 ft (290 m) long and 150 ft (46 m) wide, was needed for the 30 ft (9 m) deep tunnel completely below grade. When finished, the tunnel will ultimately support the load and provide resistance from impact for a jet runway and provide a path for three roadways into a new midfield terminal now under construction.

A joint venture of Walbridge Aldinger and Posen Construction, Utica, Mich., through a contract with the Michigan Department of Transportation (MDOT), the placement, using a 5,000 psi (35 MPa) mixture design without air entrainment, consumed 18,900 tons of aggregate, 15,750 tons of sand, 7,078 tons of cement, and 4,400 gal. (17,000 L) of midrange water-reducing admixture, translating into roughly $1.5 million in concrete materials alone. The North Tunnel project accounts for one-third of the volume of concrete used in the entire project. Also 4,400 tons of rebar were used in the project. 1,600 tons were used in the footing alone. Total usage included 2,400 tons of "black bar" and 2,000 tons of epoxy-coated rebar.

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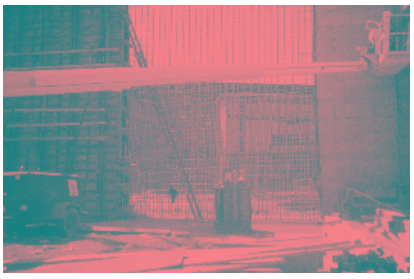
Setting sights on the record

Scheduling began more than a year prior to the 23-hour placement. Plans initially called for the foundation to be placed in 16 separate sections. Early on however, it became apparent that the concept of one combined placement seemed preferable. Otherwise, operations at Detroit Metro Airport would have been interrupted for each individual sectional placement. Also, if construction activities were scheduled continuously during late night and early morning hours, a time when air traffic is usually minimal — the issue of conflict with airport operations would be eliminated.

Suppliers to the project had total commitment. One example was the rebar supplier and installer who had to provide more than 1,600 tons of reinforcing for the foundation. It all had to be installed within a 4-week period to keep the other phases of the project on schedule. "That's probably a year's worth of work for most companies — it's just an unbelievable amount of steel," said Kenneth Beaudoin, Vice President, Walbridge Concrete Services.

The cement supplier for the project had the same commitment. Once the supplier chosen was apprised of the



advance planning going into the project, they informed the contractor that no other cement company would need to provide material. They reaffirmed this by sending a shipload of cement exclusively for the placement.

The excavating contractor worked under constraints that tested the company's capabilities. Roughly 1 million yd^3 (800,000 m^3) of earth and fill were removed from the job site.

Cooperating on a major scale

Meetings were held with material and equipment suppliers on a constant basis for 6 to 8 months prior to the placement in an attempt to foresee and forestall any potential problems. One special meeting was seen as pivotal just 4 weeks prior to the anticipated target placement date.

That prejob meeting helped foster a "one team" approach that prevailed between labor and management throughout the remainder of the project. For example, to minimize injury risk and promote productivity, the general contractor spent an extra $60,000 for steel mesh to cover the reinforcing mat so workers could walk on the rebar steel without the danger of falling through. Cooperation was also extended by the labor force, essentially all volunteering to work as many hours as needed.

During the pour, a wet concrete edge had to be maintained to avoid construction cold joints. To ensure this, a minimum of 400 yd^3 (300 m^3) of concrete per hour had to be placed. As it turned out, the concrete placement volume readily exceeded that required amount throughout the operation. In beginning each section, concrete was first pumped to a depth of 1.5 ft (0.5 m) in the foundation reinforcing mat. For each sectional area, in increments of about 10 ft (3 m) square, laborers maneuvered the pump hoses back and forth to top off a section; the edge was then worked all the way out.

Assessing the record's impact

"Still, to run 23 hours without stopping is the most remarkable feat I've ever seen," Beaudoin reflects. Even under those exhausting conditions, concrete workmanship and quality did not suffer: 3-day core breaks were almost to strength, and the 7-day tests were well above the 5,000 psi (35 MPa) specification. Another impressive aspect is that everyone on the job site made it through without injury: more than 7,000 man-hours were logged that day with zero injuries.

Principal companies involved in this project include:

GENERAL CONTRACTOR
WALBRIDGE ALDINGER, Detroit, Mich.

CONCRETE SUPPLIER
MICHIGAN FOUNDATION CO., Trenton, Mich.

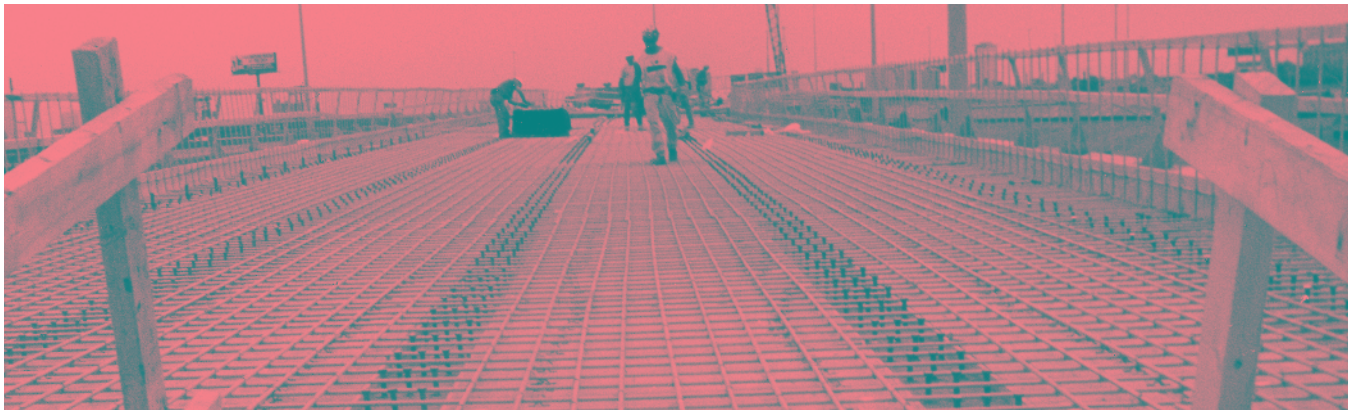
REINFORCING STEEL INSTALLER
QUALITY RESTEEL, Brighton, Mich.

EPOXY COATED & UNCOATED REBAR SUPPLIER
LOFLAND COMPANY, MIDWEST, Indianapolis, Ind.

CEMENT SUPPLIER
BLUE CIRCLE CEMENT, Marietta, Ga.

This material was excerpted from *Concrete International*, Nov. 1999 issue. Photos supplied by *CI*. For additional information, contact *CI*, P.O. Box 9094, Farmington Hills, MI 48333 or by phone at (248)848-3700, fax (248)848-3701. ◆

IDOT Rebuilds The Stevenson Expressway Using Epoxy-Coated Reinforcement



On February 18, 1999 IDOT (Illinois Department of Transportation) announced the $567 million reconstruction of Chicago's Stevenson Expressway. The expressway is over 30 years old. In human terms, it is far from old, but for an expressway in Chicago, thirtysomething is ancient. The boundaries of the Stevenson reconstruction are the Dan Ryan Expressway (I-90/94) at the east and the Tri-State Tollway (I-294) at the west.

When the Illinois Department of Transportation (IDOT) first opened the road in 1964, it was called the Southwest Expressway. The roadway was officially dedicated as the Stevenson Expressway shortly after the death of Illinois Governor Adlai Stevenson in 1965. In those early days, the average daily traffic load was about 22,000 vehicles. Today, it's about 160,000 with a truck volume of 15 percent, which is among the highest in the Chicago area. The pounding of all those cars and trucks, combined with extremes of weather and the corrosion of road salt, has taken its toll.

Because of the Chicago area's difficult winters, work on the Stevenson Expressway, nicknamed "Mission I-55", will run from March through the end of October in both 1999 and 2000. While each year's construction is scheduled to end on October 31, work is always subject to weather-related delays. However, financial incentives for contractors to complete work before the end of the construction season are in place.

IDOT is replacing deteriorating bridge decks, dozens of bridge supports and shoulders. IDOT is also constructing safer exit and entrance ramps, new retaining walls and medians, improved overhead lighting, and modern roadbed, all similar to what was done on the Kennedy Expressway (I-90/94) in the early 1990s. The total cost of the reconstruction of the Stevenson Expressway includes the 1997 and 1998 preparation of the alternate routes — Archer Avenue, Ogden Avenue and Joliet Road — for diverted Stevenson traffic, the 1999-2000 rebuilding of the actual Stevenson roadway, entrance and exit ramps, and the post-2000 follow-up work including aesthetic improvements and updated traffic surveillance technology.

Kirk Brown, Secretary of Transportation for IDOT, said that the reconstruction of the Stevenson Expressway is one of several projects in the Chicago area designed to make

IDOT Rebuilds The Stevenson Expressway. . . continued from page 3

driving in the region safer and more efficient. "Some 34 years of car and truck traffic — and the current 160,000 — 175,000 per day vehicle volume — has taken its toll, primarily on the elevated roadway from California to the Dan Ryan," Brown said.

The project will incorporate a state-of-the-art design for a 50-year design life for the new bridge portion from east of California Avenue to east of Ashland Avenue. The deck of the bridge will have a 25-year service life with regular maintenance.

During construction IDOT will keep traffic moving by:

- IDOT Minuteman patrols will assist disabled vehicles.
- Shoulders for disabled vehicles are located every quarter of a mile.
- Additional State Police patrols will enforce speed limits, handle accidents and keep traffic moving.
- Changeable message signs will display traffic information.
- Advisories about traffic, lane closures and other developments will be available on commercial radio stations.

Phase I completed ahead of schedule

Ten days ahead of the scheduled Oct. 31 completion, IDOT announced the conclusion of Phase I reconstruction for the Stevenson Expressway from Kedzie Avenue to Canal Street. All three inbound lanes were completed and reopened by 5 a.m., just in time for morning rush hour. However, exit ramps to Damen and Ashland Avenue had to remain closed until November. At the same time the Des Plaines River Bridge in both direction was also scheduled for a November completion date.

"Unforeseen conditions caused last-minute design changes to a pier that supports the bridge, forcing a slight delay in its completion," said Bruce Dinkheller, IDOT's engineer of project implementation.

Until construction restarts in March 2000 on the outbound side, drivers will continue with the current configuration of two lanes from Canal Street to Kedzie Avenue.

"Outbound drivers still have some bumps to contend with on the 35-year old roadway," Dinkheller said. "Before winter completely sets in, IDOT will have work crews patching various sections. Our plan is to perform that maintenance during off-peak hours."

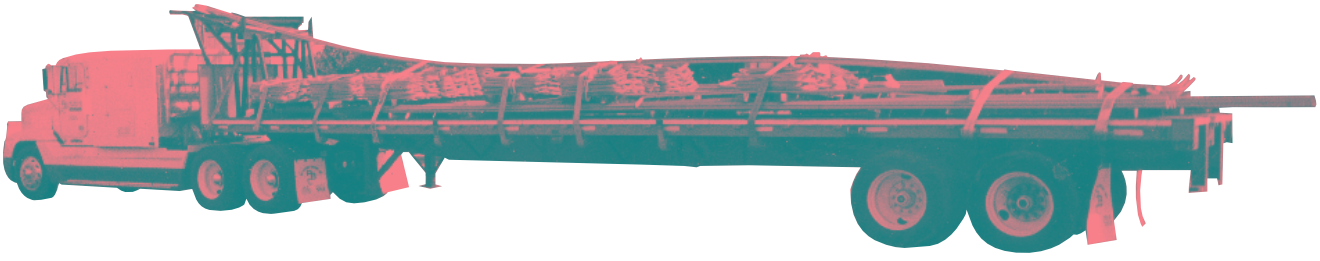
When all the work is complete in mid November, the inbound Stevenson will include all the modern engineering enhancements designed to make travel safer for all drivers. They will notice:

- Grooved concrete surface for water displacement and drainage.
- New and improved lighting along the roadway.
- Dedicated ramps for exiting vehicles at Damen, Ashland, the northbound Dan Ryan, and the southbound Dan Ryan. All were constructed to handle more vehicles and keeps the exiting traffic safely separated from the faster mainline traffic.

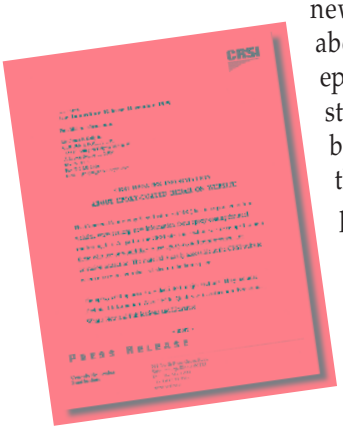
In March 2000, reconstruction begins on the outbound lanes from Canal Street to Kedzie Avenue, and from the Des Plaines River Bridge to La Grange Road. In addition, IDOT's plans call for major patching and resurfacing work in both directions from Kedzie to the Des Plaines River Bridge.

In the first phase of construction, completed in 1999, approximately 7,500-8,000 tons of epoxy-coated rebar were used in all areas of construction. This material was supplied by ABC Coating.

The pavement is continuously reinforced concrete pavement (CRCP) with epoxy-coated rebar throughout. Epoxy-coated rebar is also used throughout the reconstruction project in all substructure above ground elements including columns, pier stems, pier caps, bridge decks, retaining walls and parapet walls. For updated information, including maps and general information about Mission I-55, visit IDOT's web site, http://dot.state.il.us/i55. ♦



Introducing the New Epoxy-Coated Reinforcement Web Site



Recently incorporated into the Concrete Reinforcing Steel Institute (CRSI) web site — www.crsi.org — is new information about the use of epoxy coating for steel reinforcing bars. Just access the CRSI home page and then click on the Epoxy Coated Rebar heading.

The site was designed to keep the industry aware, with immediate access, of all available information concerning the use of epoxy coating as corrosion protection for steel reinforcing bars.

Information is grouped into 6 major areas, including: About ECR, Technical Information, Quality & Certification, Economics, What's New, and Publications & Literature. Also included are areas for Frequently Asked Questions (FAQs) and Contact Us. The site links to ASTM, ACI, FHWA and others to keep you aware of practices, procedures and new developments around the industry.

Files that contain reports prepared by CRSI and other agencies are available for quick, easy downloading — either for reading or desktop printing. The site also lets users order printed materials using a shopping cart collection approach now common on many e-commerce web sites.

About ECR

This section explains the need for corrosion protection, provides the material's description and lists the manufacturing steps: surface preparation of the steel, heating of the steel, powder application and curing. Also explained is the history of the material and its applications, as well as the continued growth in the marketplace since the 1970s. Information is provided in both written and graph form. Performance is discussed in conjunction with life cycle costs. Easy to read charts compare structures that use epoxy-coated reinforcement against those that do not.

www.crsi.org

Technical Information

In use for over 25 years, performance findings are discussed in numerous studies by research organizations and government agencies. Available in this area for downloading, viewing or desktop printing are reports, produced by CRSI, but written by independent agencies and authors. In addition, information from FHWA studies is available.

Quality and Certification

The CRSI Epoxy Plant Certification program, now used by more than 90% of all applicators is reviewed. All certified plants in the United States and Canada are listed.

The complete 44-page Plant Certification Manual, which fully explains the policies of the certification program, is available for downloading. Also included are two illustrated brochures and companion videos that include information about fabrication and field handling procedures used with epoxy-coated reinforcement. The brochures and videos are available for purchase from CRSI.

Economics

Using epoxy-coated reinforcement in the last 25 years has proven to reduce overall costs by extending life cycles. The cost as a percentage of reinforcing steel cost and overall building cost is also reviewed.

Compared are bridge decks using reinforcing steel without epoxy coating, bridge decks with epoxy coating on the top mat only and bridge decks with epoxy coating on both mats. Also compared are parking garages. Comparative information helps the user better understand all of the elements that need to be reviewed when doing life cycle costing.

Two brochures covering cost-effective epoxy-coating for bridges and parking garages can be downloaded, viewed, desktop printed or are available in printed form from CRSI.

What's New

Included in this section are the most recent press releases covering information available from the CRSI Epoxy Marketing Group, technical reports and a list of upcoming industry events.

Epoxy-Coated Reinforcement Web site . . . continued from page 5

Publications/Literature

Developed for instant access to informative literature produced by CRSI, or for easy ordering, this area allows the user to easily order printed copies just by clicking the corresponding box.

Comments

Get your questions answered, list your concerns, and communicate with the epoxy marketing group by e-mail.

FAQs

Included are a number of questions that are frequently asked about the use of epoxy-coated rebar. These FAQs (Frequently Asked Questions) include both technical and procedural material.

Updates will occur as changes take place within the industry. New materials will be featured in the What's New area, where you can easily access it.

CRSI Website: www.crsi.org

The epoxy section of the CRSI web site was designed for you. Your comments and suggestions are always welcome. Go to www.crsi.org and visit the new epoxy site online. ♦

Plant Certification Program Continues to Grow

The CRSI Epoxy Plant Certification Program initiated in 1991, continues to grow in both the United States and Canada. Presently more than 90% of all applicators in North America use the program to guarantee the production of quality epoxy-coated steel reinforcing bars required by state highway agencies and Canadian provinces. Also, the Federal Highway Administration supports the use of certified material and encourages state Departments of Transportation to require plant certification.

To help those who use or would like to use epoxy-coated reinforcement a series of seminars - 12 in all - took place in 1999. More are planned in 2000. Material covered in the seminars includes fabrication and field handling procedures.

Because the industry has self imposed such high standards, the program has helped set higher standards by both ASTM and AASHTO. Each group monitors changes within the industry and incorporates changes or modifications to the standards they produce. This may include changes in existing tests, new tests or new standards for finished material. AASHTO Construction Specifications require CRSI Certification for epoxy coating applicators and they are recommended in ASTM Specifications.

Monitored by an outside agency, more information, including the 44-page CRSI Certification Manual, can be found on the CRSI web site, under Quality & Certification. The certification program includes both scheduled and non-scheduled inspection by the outside agency. Plants are rated according to industry standards and tests incorporated by the epoxy certification committee.

States/Provinces Requiring Certified Plants

Arkansas	Oregon
Idaho	Utah
Indiana	Utah
Kansas	West Virginia
Minnesota	Wisconsin
Nevada	Alberta, and
New Hampshire	Ontario
North Carolina	

For additional information about the Certification Program, a Certification brochure, or other material, contact Theodore L. Neff, P.E., CRSI Certification Program Administrator. ♦

A New Feature in the Anti-Corrosion Times is For Frequently Asked Questions About Epoxy-Coated Rebar

The following questions are often asked of CSRI staff, and come from the CSRI website. To have your questions answered visit the epoxy-coated rebar area of www.crsi.org and contact us.

FABRICATION

Question:

What is the recommended way to specify epoxy-coated reinforcement?

Answer:

A good specification will help assure that high quality epoxy-coated reinforcement is supplied to your project. Although many agencies have their own variation, it is recommended that the standard ASTM specifications be used, depending on whether the bars are to be fabricated before or after coating.

FOR COATING BEFORE FABRICATION, USE:

ASTM A775/A775M-97 (Coating Application and Powder Qualification)

ASTM D3963-99 (Fabrication and Field Requirements, Repair Material Qualification)

FOR COATING AFTER FABRICATION, USE:

ASTM A934/A934M-96 (Coating Application, Field Handling, and Powder/Repair Material Qualification)

Whatever specification is used, it is particularly critical that all aspects of supplying the product be adequately specified, namely, coating application, fabrication, field handling and material pre-qualification. Care should also be taken to ensure that the latest version of standard specification is used. Over the years, many positive changes have been made to the standards.

FABRICATION

Question:

Is epoxy-coated reinforcement coated before or after it is fabricated (i.e. bent and cut to length)?

Answer:

Reinforcing steel can be epoxy coated either before or after it is fabricated. The most common method is to coat the steel in straight lengths (typically 40 to 60 feet long), and then cut and bend the bars as specified. The straight bars are moved through the coating process on a conveyor system, which permits high production capacities. Most applicator plants in North America utilize this method of coating.

A few custom coating facilities have the capability to coat rebar and other steel shapes after it is fabricated. Typically, in this process, individual bars are hung from a conveyor system and moved through the coating process. Epoxy-coated welded wire mesh is coated in this manner.

Quality epoxy-coated reinforcement can be produced with either method of coating application. Coating the traditional straight bar way has the advantage of being more cost effective, but the disadvantage of potential fabrication damage. On the other hand, coating after fabrication is more labor intensive and costly, but eliminates most damage caused by bending.

COST

Question:

How much does epoxy coating add to the cost of steel reinforcement?

Answer:

Although the exact cost for any specific project will vary depending on location, job complexity, quantity, proximity of suppliers etc., epoxy coating will typically add about 25 percent to the installed price of reinforcement. For most structures, this equates to only a 1% to 2% increase in the overall structural cost. A small price, particularly when compared to the high cost of repair and maintenance of corrosion-related distress.♦

PennDOT and NYSDOT study long-term corrosion protection for bridge decks

The New York Department of Transportation (NYSDOT) and the Pennsylvania Department of Transportation (PennDOT) recently collaborated on a joint research study to evaluate the effectiveness of epoxy-coated reinforcement in bridge decks. The study was performed by CONCORR Inc., Ashburn Virginia, and was jointly funded by NYSDOT, PennDOT and FHWA.

Field evaluations were conducted from September 4 - 19, 1996 in NY, and from September 30 - October 15, 1996 in Pennsylvania. The Final Report was published November 24, 1998.

The objectives of the study were to:

1. investigate the field performance of epoxy-coated reinforcement
2. determine if ongoing or progressive corrosion and/or reduction in coating adhesion were occurring,
3. define variables associated with exposure conditions and concrete/epoxy-coated reinforcement properties.

Decks constructed between 1977 and 1993 were considered for study and were randomly selected from among a population of 1,425 decks in NY and 2,290 in Pennsylvania. This population equaled, in New York, a total of 3,360 spans representing 16.6 million square feet of deck area and in Pennsylvania, a total of 6,062 spans representing 26 million square feet of deck.

A "sampling population" of 40 spans in each state was identified for evaluation. Decks selected were statistically representative of the overall bridge population in each state in terms of age, salt usage, and condition rating.

Study Methodology

For the field study, three cores were taken from randomly selected locations on each of the 80 spans. In addition to the core sampling, field evaluations included delamination and crack surveys of each span. The condition of each deck was visually evaluated using a deck condition rating similar to that used for the National Bridge Inventory System (NBIS).

Detailed lab methodology was used to document the condition and specific properties of bars and concrete. Concrete tests included chloride ion content, permeability, pH, and percent volume pore space among others. Coating tests and observations included the number of defects/bare areas, thickness, hardness and adhesion rating among others. Core properties were documented in terms of delamination, cracking, concrete cover and electrochemical impedance spectroscopy (EIS) measurements.

Key Findings

The study identified several pertinent findings including:

1. The variables of the logarithm of EIS, the number of holidays, and the number of bare areas were the best predictors of corrosion condition rating, but in all cases, the correlations were weak.
2. Corrosion condition rating did not correlate well to coating thickness, concrete cover, epoxy color or deck condition rating.
3. Adhesion reduction/loss is irreversible at least after a 7-day drying period. There is a higher probability of adhesion reduction adjacent to areas with visible coating defects compared to those without.
4. Concrete resistivity correlated well with coulombs passed.
5. pH testing and pencil hardness testing did not provide any useful information.

The scope, methodology and findings of this study are presented in much greater detail in a full final technical report entitled, *"Verification of Effectiveness of Epoxy-Coated Rebars"*. The Pennsylvania DOT Report No. PA99 0001+94-05 is available from the National Technical Information Service, Springfield Virginia.

A 10-page article summarizing this study also recently appeared in the November/December 1999 issue of the Federal Highway Administration's ***Public Roads*** magazine. CRSI has reprinted this article, which is available upon request. Visit the CRSI website for more information, or contact CRSI directly by phone, fax or mail.♦

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