IMPLEMENTATION PLAN AND PROJECT PROPOSAL Version 1/23/2015	LRRB INV #: SP&R #: ARTS Project #:

TITLE OF PROJECT:

OmniScan Phased Array Ultrasonic Corrosion Imaging System

PROJECT PROPOSED BY: Ed Lutgen

POSITION AND MNDOT OFFICE OR DISTRICT: Bridge Office Construction and Maintenance Engineer

TOTAL BUDGET $_60,000___

SOURCE	AMOUNT
MnDOT State Research Funds…	$
Office or District Funds……...	$
Federal SP&R……(__%)	$
LRRB……	$
Other:_____	$

OVERALL PROJECT SCHEDULE

DATE PLAN COMPLETED: March 2016
(allow time for review, approval and contract process)
PROJECT START DATE: May 2016
PROJECT LENGTH (MONTHS): 24 months

PROJECT OVERVIEW AND GOALS

Corrosion of steel due to deicing chemicals is a serious problem for Minnesota's bridges. Corrosion mapping is an important aspect of bridge inspection. Accurate metal thickness measurements are essential for determining load capacity of structural members on bridges and structures.

The OmniScan Phased Array Corrosion Mapping System provides detailed three dimensional images of the cross sectional loss of member thickness that conventional ultrasonic equipment cannot provide. This gives engineers better tools to visualize and evaluate the condition of bridges than was possible in the past. With the future purchase of additional transducers, the OmniScan can also be used for enhanced inspection of welds and bridge pins.

MnDOT PROJECT MANAGER OR TECHNICAL LIAISON

Kenneth Rand
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APPROVALS

OFFICE DIRECTOR OR DISTRICT ENGINEER	Signature of Office Director or District Engineer:
Office or District:_B**ridge Office**_____ I hereby certify sufficient staff time will be scheduled for the Project Manager and staff to complete the project as outlined in the attached work plan, and commit any Office or District funds as listed above.	_____ Kevin Western Date:
DIRECTOR OF RESEARCH SERVICES SECTION	Signature of the Director of Research Services:
Approval of work plan and any MnDOT State Research Program funds as listed above.	_____ Linda Taylor Date:

IMPLEMENTATION PLAN AND PROJECT PROPOSAL

INNOVATION ROADMAP INFORMATION

1) What are the expected benefits to MnDOT from implementing the results of the project? What is the impact on the department?

Impact: The OmniScan System would increase the quality of the data provided to the structural engineers. It would also provide bridge inspectors the most up to date data collection equipment available on the market.

Benefits:

- Decrease Engineering/Administrative Costs (Inspection costs, paperwork)
- Increase Lifecycle
- Operation and Maintenance Savings (Materials, labor, equipment, time)
- Technology (Technology transfer, new materials, new methods)
- MnDOT's WIG and asset management program is focusing on lifetime costs of bridge maintenance and preservation. The OmniScan could be a valuable tool in helping to determine these costs.

The increasing costs of bridge inspections are a concern for the Minnesota Department of Transportation (MnDOT) and local agency bridge owners. The OmniScan will result in bridge inspection cost savings due to faster acquisition of field data. This will also result in cost savings to the bridge owners because of reduced traffic control, equipment usage and support. The enhanced data collection will save the engineering department time by reducing data collection and evaluation.

2) What transportation problem is this project solving? What has been attempted in the past to solve this problem and what remains to be solved?

The transportation problem to be solved is providing steel thickness data to determine the life cycle and maintenance needs of steel bridges.

Mechanical measurements were originally used for corrosion determination. Manual ultrasonic measurement techniques were the next generation of data collection, but this is a time consuming method. Linear phased array is the latest state of the art thickness data acquisition technology.

By comparing the enhanced computer generated imaging obtained by the OmniScan to the spreadsheet obtained from conventional thickness measuring methods, our engineering staff should see the potential more accurate calculation of section loss. This information would be included in our standard inspection reports or reports prepared just for special inspections.

3) Additional information about the project and goals:

Project goals:
1. To provide structural engineers with the necessary data to calculate load capacities of bridges.
2. To establish baseline measurements of structural members susceptible to active corrosion in order to predict future funding and maintenance needs.
3. To provide accurate data in a fraction of the time currently required using conventional measurement techniques.

4) How does the proposed project build upon previous research? If further research is proposed, why does similar previous research not solve the Minnesota transportation problem being addressed and why is further research needed?

The Phased Array Ultrasonic Corrosion Mapping System has not been researched by MnDOT.

MnDOT has funded several research projects on detecting cracking in steel members, but none on corrosion measurement. This project is a pilot test and evaluation in Minnesota of commercially available new technology. Other studies involving linear phase array include:

Experiences from Ultrasound Testing – Olympus Omniscan MX and DolphiCam CF08/CF16 by the Norwegian Defence Research Establishment (January 2016) - http://www.ffi.no/no/Rapporter/15-00589.pdf

Comparative Testing of Radiographic Testing, Ultrasonic Testing and Phased Array Advanced Ultrasonic Testing Non Destructive Testing Techniques in Accordance with the AWS D1.5 Bridge Welding Code by the University of South Florida (February 2014) - http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_SMO/FDOT-BDK84-977-26-rpt.pdf

Evaluation of Phase Array Ultrasonic Testing for Bridge Inspection by the Iowa Department of Transportation and the Federal Highway Administration (October 2013) - http://www.iowadot.gov/research/reports/Year/2013/fullreports/Phased%20array%20UT.pdf

Getting Phased Array Approvals and Certifications by Olympus NDT (October 2008) - http://www.ndt.net/article/wcndt2008/papers/83.pdf

As bridge designs and environmental conditions differ in varying regions, it is prudent to investigate this technology in Minnesota.

5) How will the results of the completed project be put into practice and deployed by MnDOT? Who needs to make a formal decision to implement and deploy, and who would be responsible for implementation and deployment?

A decision to deploy rests with the State Bridge Inspection Engineer.

The project will develop the following end-user products:

- The OmniScan is an ultrasonic measuring system that will be used to perform an enhanced continuous scan that is digitally recorded and can be archived for future comparisons. Inspection time using this technology will be reduced. The Minnesota Bridge and Structure Inspection Program Manual will be updated accordingly on this new technology in the non-destructive testing section.
- Manual, handbook or field guide
- Tool or piece of equipment
- Test or inspection method
- Instrument or measurement system
- Streamlining or automation

Technical advisory panel or project steering committee:

- William Nelson - Non Destructive Testing Technician
- Kenneth Rand - Non Destructive Testing Technician
- Jennifer Zink - State Bridge Inspection Engineer

MnDOT specialty offices: Bridge Office

MnDOT Districts and District functional groups:

- District Bridge Maintenance Supervisors
- District Bridge Engineers
    - Informed by Bridge Office

Additional key practitioners or management champions:

- Ed Lutgen - Bridge Office Construction and Maintenance Engineer

Management group:

Practitioner committee:

- Structural Engineers, informed by Jennifer Zink, State Bridge Inspection Engineer

Other cooperating program or agency:

Other stakeholders:
- County or Local Bridge Owners

Others who may be interested, not listed above:
- Local Road Research Board

MnIT involvement (software, data management, or technology devices):
- Includes a request for software license for one computer, a dedicated laptop capable of handling the high graphics and amount of data associated with the software.

Items for State contract or Approved Products list: n/a

Intellectual Property or licensing:
- Software license

6) What future efforts or steps will be needed to derive full benefits from the expected results of this project?

MnDOT is committed to the following future steps:
- The Bridge Office inspection personnel will develop and write inspection procedures
- The Bridge Office non-destructive testing technicians will train other inspectors in the department
- The Bridge Office would determine what other bridges this technology would be useful for.

7) Communication Plan

Catch phrase for marketing:

Improving Bridge Inspection through Corrosion Imaging

Target audience for early communication (in addition to those named above):
- Bridge Inspection unit and
- Bridge Engineers
- Bridge Owners

Early Communication plan:
- Small group discussions
- Videoconference meeting
- Email exchange
- Early discussions would take place at scheduled inspection Unit Meetings and/or meetings with the equipment vendor and data analysis consultant.
- Further coordination with the bridge owners would be accomplished through Email communication or Video or teleconference calls.

Target audience for rolling out the innovation:
- The target audience is the bridge owners, bridge engineers, maintenance and inspection staff.
- End users would be the Inspections Unit.

Roll-out message, methods and activities:
- The OmniScan is an ultrasonic measuring system that will be used to perform an enhanced continuous scan that is digitally recorded and can be archived for future comparisons.
- Inspection time using this technology will be reduced.
- The Minnesota Bridge and Structure Inspection Program Manual will be updated in the non-destructive testing section.

Roll-out timing and responsibilities:
- Bridge Office Inspection Team is responsible for all... Lead time estimation for the events below is about one month.
- Presentation to a conference
- Internal office meeting
- Powerpoint slide show

- Include in other scheduled training
- MnDOT 'Newsline' article
- Research Services social media blast
- Communication could be made during scheduled unit meetings, or perhaps a tabletop demonstration during our annual office meeting.
- A presentation could also be made during our statewide Bridge Inspector Annual Refresher courses and the Bridge Workers Safety and Training Conference (April).

NOTE TO USERS: It is usually not practical to use research funds to pay MnDOT salaries, except for projects using SP&R or LRRB funds where personnel from the Office of Materials and Road Research serve as the principal investigator. Contact MnDOT Research Services Section for additional information.

Additional information about funding eligibility for the Implementation Program:

1. **Address Problem or Need**
   The proposal needs to clearly state the transportation problem being solved or need that is being satisfied
2. **Research Link**
   The Implementation proposal must include a reference link to a national, state or local research project that has been completed. If the reference link is not provided, this could reduce SP&R participation. Examples of research can be linked to any of the following federal, state or local programs:
   a. Federal Program
      i. NCHRP project or other Federal Cooperative Research Programs
      ii. Pooled Fund Project (MnDOT lead, MnDOT participation in pooled fund project/program, or single state project)
   b. State Research
      i. MnDOT Research Project
      ii. Other State DOT Research Project
      iii. Intelligent Transportation System (ITS) Inst. or MN Guidestar Program
      iv. MnDOT's Maintenance New Technology Research and Equipment Committee (NTREC) program
      v. MnDOT's Cold Weather Test Facility - (MnROAD)
   c. Local Research
      i. Local Road Research Board (LRRB) research projects
3. **Demonstrate Application for department**
   The proposal needs to indicate how the results of the implementation project will be used or applied within the department. If possible, state how the results could lead to full implementation in day-to-day practice and whether there is commitment to support implementation statewide
4. **Internal Champion –** implementation proposals must identify a MnDOT staff person as the champion to move forward for funding consideration.
5. **Other Considerations:**
   Equipment purchases
   a. Should be kept to a minimum and only include items necessary to support the implementation project.
   b. Can be used as seed money to demonstrate the viability of the equipment. Pilot project proposed should be limited to a specific area or location.
   c. Not intended as a funding source for full deployment of equipment through the state.
   d. Can't be used to supplement equipment budget.
   Construction Project
   e. Extremely difficult to use research dollars to fund construction projects.

PROJECT WORK PLAN INFORMATION

BACKGROUND: Include any background information or history pertinent to the project that has not been provided above.

- The initial phase of the work will be accomplished in conjunction with our scheduled inspection of the Wabasha MN bridge. Traffic control and lane closures will already be provided.

SCOPE: Briefly summarize the scope of work of this project. This includes an overall description of how the project will be conducted. Please summarize coordination with other projects or other work that is necessary for completion of this project, such as specialized help or input including data, materials, equipment, facilities, etc.

Scope: The equipment vendor will be providing training and support, the cost of which is included in the purchase price of the equipment. Several of the vertical and diagonal members of the Wabasha bridge will be scanned to determine the extent of section loss caused by water infiltration in the members. This data will be compared to the traditional method of ultrasonic testing along with a time savings comparison. The information will be processed and given to the designated consultant for analysis. Four additional bridges will also be inspected and analyzed.

The data obtained, from up to 5 bridges, would be presented to a consultant familiar with bridge inspection and non-destructive testing to analyze the data and compare to ultrasonic testing methods on the basis of accuracy and time. The consultant would be present during the training and inspections, or at least some, to be familiar with the equipment and methodology. It is also expected that the consultant would investigate previous and current research as part of their work. A report on the findings would be produced by the consultant to provide a baseline going forward. The project will be on-going as needed in the future to track bridge condition by the Bridge Office.

Equipment: OmniScan SX portable Phased Array acquisition unit, 32 Element Phased Array Probe, Mini encoder, OmniScan PC Toolkit (software).

Consultant: A consultant that is expert in bridge inspection and NDT will be selected either single-source or by RFP from the pre-qualified list.

Cost: $60,000 ($29,664 for equipment, software, and training; $5,000 for dedicated laptop; $25,000 for consultant contract.)

Schedule: 24 months for planning, inspection field work, data analysis, report

TASKS: List the major tasks in the sequence necessary to complete the project, including the elements listed below.

TASK 1:
Purchase equipment– MnDOT Bridge Office Inspections Unit
May 2016
$35,000

TASK 2:
Set up consultant contract - MnDOT Bridge Office Inspections Unit and Research Services
May-July 2016
$25,000

TASK 3:
Train and pilot test equipment on Wabasha Bridge (June 2016) and additional bridges (July-September 2016 and May-September 2017) - MnDOT Bridge Office Inspections Unit and Consultant
No additional cost
Observe NDT inspections – Consultant
Included in $25,000 listed in Task 2

TASK 4: Investigate other research completed worldwide in comparison and evaluate results to present in the written final report for publication – Consultant. September 2017 – March 2018 Included in $25,000 listed in Task 2
SCHEDULE SUMMARY: List each task, start and end dates, or attach a Gantt chart. **May** – July 2016: Procurement **June, 2016** – September, 2017: Field test Phased Array Test Equipment **September, 2017** – March, 2018: Write Final report

DETAILED BUDGET FOR ENTIRE PROJECT

DOLLAR AMOUNT (OMIT CENTS)				
SALARIES (NAME/ROLE)	**FY 2016**	**FY 2017**	**FY 2018/19**	**TOTALS**
DIRECT COSTS				
CONSULTANT, CONTRACTOR AND TESTING COSTS (list each contract and its expected cost)		**$15,000**	**$10,000**	**$25,000**
EQUIPMENT (itemize by vendor) OmniScan and Laptop	**$35,000**			**$35,000**
TOTAL PROJECT COSTS	**$35,000**	**$15,000**	**$10,000**	**$60,000**

BUDGET BY SUMMARY TASK AND CONSULTANT/VENDOR:

(List task number and dollar value for each task in the work plan. If the project includes consultant contract or vendor P.O., provide breakdown of task budget. Insert additional rows as necessary.)

Task Number	Task Description	Consultant, Vendor or Contractor Name	Cost
1	Purchase equipment	OmniScan	$35,000
2	Consultant Contract	TBD	$15,000 (est)
3	Pilot test equipment	MnDOT	$0
4	Final report	Consultant TBD	$10,000 (est)
		TOTAL PROJECT COSTS	$60,000

COMMENTS/JUSTIFICATION